

April 27, 1959

Aviation Week

Including Space Technology

SPECIAL REPORTS:

- Swedish Air Alert
- Molectronics

75 Cents

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Westinghouse Process
For Semiconductors





Here's real **FASTENER POWER** **KAYNAR: 160,000 PSI**

It's here... a powerful, new Kaylock line... now a whopping 160,000 psi! Smallest, lightest, strongest self-locking nuts ever made. Tailor-made by KAYNAR for 160,000 psi NAS high tensile short thread screws and bolts.

Latest addition to the KAYLOCK line is the H14 lightweight line... best wrench clearance for narrow flanges... mightiest lightweight yet!

NEW H14 SAVES MOST IN SPACE • SIZE • WEIGHT

STRONGER—Strength to weight ratio increased up to 218%.

LOWER—Same low height as NAS 675.

LIGHTER—70% to 40% below H10 or NAS 679 under full stress.

SMALLER—By 2 to 3 inches over than standard AN and NAS nuts.

SPACE SAVING—Narrowest flange gap. Merges bolt close to head, under the wing or design.

SELF-LOCKING—Web patented self-locking principle.

MATERIALS—Available in carbon steel for 150°F applications. These configurations also in AMS4038 and A286 corrosion resistant steel.

KAYNAR MFG. CO., INC.—KAYLOCK DIVISION
World's largest and oldest manufacturer of lightweight, all metal self-locking nuts. Home office and plant: Wyke Road 2005, Townsend, Ames, Los Angeles 14. Branch offices, warehouses & representatives in Wichita, Kansas; New York, N.Y.; Atlanta, Georgia; Cincinnati; Allentown, Penn. Ltd., Montreal, Quebec.



FOR COMPETITIVE REASONS we explore your projects with an eye to "winning off the job." Send today for Kaynar's new full line of nuts of 160,000 psi self-locking nuts.

NOW IT'S
"FABRICATE-THEM-YOURSELF"

USING
Bondolite

STRUCTURAL SANDWICH MATERIAL

NOW AVAILABLE IN STANDARD FLAT PANELS

New electronic boxes, mounting panels, mobile equipment shelters and primary aircraft structures—including bulkheads, decks, doors and radars—can be fabricated from lightweight structural sand which panels in your shop with ordinary shop equipment!

For Goodyear Aircraft Corporation now makes available for immediate delivery its BONDOLITE—standard flat panels of popular sizes (3' x 10' and 4' x 10') in a variety of core and gauges, all meeting rigid military specifications. **WHITE**. For the complete list, specifications, and copy

Fabricate-It-Yourself instructions prepared by Goodyear Aircraft—a pioneer builder of rigid, lightweight structures. Goodyear Aircraft Corporation, Dept. 916AD, Akron 15, Ohio

AVAILABLE TOO IN Semi-Finished Panels which offer a wider selection of face materials and over all thickness. AN 800 "Type 2" Panels for weight savings of 25% over solid materials—can be riveted or bolted just like solid sheet aluminum!

STRUCTURAL PANELS BY

GOOD YEAR AIRCRAFT

Bondolite & Composite Structures Division, Akron 15, Ohio

Plants in Akron, Ohio, and Elkhart Park, Arizona

STRIKE OF THE HAWK!



RAYTHEON-DESIGNED HAWK, missile annihilates enemy aircraft at 500 ft. altitude.



ARMY'S HAWK MISSILE is fired from mobile launcher. Launcher, launcher and support equipment can be air lifted or quickly transported by Army or Marine ground forces.

NEW ARMY MISSILE DESTROYS LOW-FLYING AIRCRAFT

This proven anti-aircraft missile operates even at tree-top heights, in the blind zone of other radar-controlled missiles.

Raytheon is prime contractor for the U.S. Army Hawk weapon system—now in production and slated for use with fast-moving Army and Marine Corps ground forces as well as for the defense of U.S. cities.



Raytheon to Electronics

RAYTHEON MANUFACTURING COMPANY, WARREN, MASS.

AVIATION CALENDAR

- May 17—Symposium on Electronic Processes, Philips, St. Sponson, N.Y.
- May 18—Symposium on Electronic Processes, Philips, St. Sponson, N.Y.
- May 19—Symposium on Electronic Processes, Philips, St. Sponson, N.Y.
- May 20—Symposium on Electronic Processes, Philips, St. Sponson, N.Y.
- May 21—Symposium on Electronic Processes, Philips, St. Sponson, N.Y.
- May 22—Symposium on Electronic Processes, Philips, St. Sponson, N.Y.
- May 23—Symposium on Electronic Processes, Philips, St. Sponson, N.Y.
- May 24—Symposium on Electronic Processes, Philips, St. Sponson, N.Y.
- May 25—Symposium on Electronic Processes, Philips, St. Sponson, N.Y.
- May 26—Symposium on Electronic Processes, Philips, St. Sponson, N.Y.
- May 27—Symposium on Electronic Processes, Philips, St. Sponson, N.Y.
- May 28—Symposium on Electronic Processes, Philips, St. Sponson, N.Y.
- May 29—Symposium on Electronic Processes, Philips, St. Sponson, N.Y.
- May 30—Symposium on Electronic Processes, Philips, St. Sponson, N.Y.
- May 31—Symposium on Electronic Processes, Philips, St. Sponson, N.Y.

(Continued on page 8)

AVIATION WEEK Including Space Technology

April 22, 1959
Vol. 32, No. 27

...and many other additional news items in this special issue of AVIATION WEEK. This issue is a must for all those concerned with the development of aircraft, missiles, and space technology. It contains a wealth of information on the latest developments in these fields, including articles on the design of new aircraft, the development of new missiles, and the development of new space technology. It also contains a wealth of information on the latest developments in these fields, including articles on the design of new aircraft, the development of new missiles, and the development of new space technology. It also contains a wealth of information on the latest developments in these fields, including articles on the design of new aircraft, the development of new missiles, and the development of new space technology.



Both ends of today's aim-hot and cold—are easily rotated through TI silicon optics.

BIRD'S IR VIEW... of a Hot Stove Pipe

THE WEDDING of optics to electronics may well be the marriage of the century...a TI-fostered union producing infrared guidance systems capable of finding, evaluating, rejecting false targets, and directing its "bird" to point-of-impact. Texas Instruments—leading producer of silicon optics for infrared applications—has achieved an intimate understanding of this and other unusual materials for specific portions of the spectrum.

In one of the nation's best equipped facilities, TI optics specialists design, grind, polish, and coat silicon lenses, prisms, windows, and other elements with the precision accuracy necessary for even the feeblest IR signals. Backed by a full-time engineering service with fast computers for design execution, the Texas Instruments optics team has the "know-how" to carry through your project from sketch pad ideas to custom-made systems. For detailed information on any phase of precision optics technology, contact SERVICE ENGINEERING DEPARTMENT.

TEXAS

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Now Available in
A-286 Stainless Steel
**CHEERY
AIRCRAFT
LOCKBOLTS**



Designed especially for High Strength—High Temperature and liquid oxygen and other corrosive applications, Cheery Aircraft Lockbolts* are now available in stainless A-286 Stainless Steel.

Available for the aircraft industry in a wide range of diameters, grip lengths and head styles in A-286.... Cheery Lockbolts are also produced in Alloy Steel

and Aluminum.

Cheery Lockbolts are structural fasteners providing simplicity and speed of installation with superior high tensile preloads.

Shop now like these.

For information on Cheery Aircraft Lockbolts, write Townsend Company, Cheery Rivet Division, P.O. Box 2187-N, Santa Ana, California.

*Standard stock parts 302/304, 316/316L, 307/307L, 304/304H and 304/304PH

CHEERY RIVET DIVISION
SANTA ANA, CALIFORNIA

Townsend Company

ESTABLISHED 1912 • NEW BRITAIN, PA.

AVIATION CALENDAR

(Continued from page 5)

- May 19-21-11th Annual National Conference, Society of Aeronautical Weight Engineers, Hotel Henry Grady, Atlanta, Ga.
- May 19-21-National Spring Meeting & Symposium, Society for Experimental Stress Analysis, Sheraton Park Hotel, Windsor, Ont., C.
- May 20-22-Second Int. Air Transport Conference, American Society of Civil Engineers, Sheraton Dallas Hotel, Houston, Tex.
- May 22-22-1977 Ohio Valley Instrument and Automation Exhibit and Symposium, Cleveland Subcom, Instrument Society of America, Niles Hall, Canton, Ohio.
- May 24-26, 5-Technique, Aeronautical Engineering International Annual Meeting, Montreal, 1978.
- May 24-27-1978 National Telecommunications Conference on Implementation of Space, Power, Pulse and Composites (Heli), Denver, Colorado American Rocket Society Institute of the Aeronautical Sciences, American Institute of Electrical Engineers and Instrument Society of America.
- May 24-27-All Industry Production and Quality Control Exposition and Conference, American Society for Quality Control, Cleveland Public Hall and Hotel Victoria, Cleveland, Ohio.
- May 25-26-Detroit Engineering Show and Conference, American Society of Mechanical Engineers, Convention Hall, Philadelphia, Pa.
- May 26-27-Symposium Transport Meeting, San Diego Section, Institute of the Aeronautical Sciences, San Diego, Calif.
- June 1-4-National Symposium, Institute of Radio Engineers Professional Group on Microwave Theory & Techniques, Sheraton University, Cambridge, Mass.
- June 6-7-Dartmouth National Conference, Institute of Radio Engineers Professional Group on Production Techniques, Villa Hotel, San Mateo, Calif.
- June 11-Annual Meeting of the Army Aviation Association of America, Sheraton Hotel, Washington, D.C.
- June 14-23-23rd Annual Symposium & Display Meeting, Bradley Aviation Society, Inc., Municipal Airport, Reading, Pa.
- June 14-15-Symposium Meeting and International Exhibition, American Rocket Society, El Centro Hotel, San Diego, Calif.
- June 15-16-1977 French International Air Show, Le Bourget, Paris, France.
- June 16-19-National Summer Meeting, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif.
- June 18-20-Instrument Pacific Council Meeting and Air Transportation Conference, American Institute of Electrical Engineers, Olympia Hotel, Seattle, Wash.
- June 20-21-11th Meeting, American Telecommunications and Manufacturing Association, Sheraton Hotel, San Francisco, Calif.
- Aug. 11-Sept. 5-1978 Annual Congress, International Aeronautical Federation, Church House, Watlington, London.
- Sept. 7-11-1978 Far Eastern Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough Fair.
- Oct. 12-16-17th General Convention of the International Air Transport Association, Tokyo, Japan.



**Avco/Nashville
experience
And.....
Convair 600**

The new Convair 600 marks a "first" in aviation—it is the first jet transport to employ the "maxi rule" concept for increased cruise speed at critical Mach numbers.

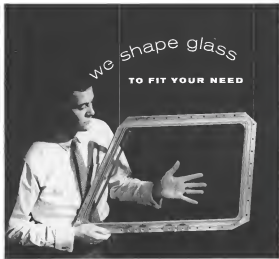
For design and production of many of its components—the horizontal and vertical stabilizers, and important parts of the wing leading and trailing edges.... Convair once again has selected Avco's Nashville Division, which already is producing important components for the Convair 580 jet liner. Both Convair plans are planned to give years of dependable airline service.

Avco/Nashville has such advanced manufacturing techniques as:

- Production of *stress*—high temperature, stainless steel *honeycomb* structures for hypersonic aircraft and missiles.
- *Aluminum honeycomb* structures for aircraft such as the Convair 580, and for other applications such as *submersible* *composites* *shells*.
- Metal *bonding* and *thermal* *welding* of lightweight *aluminum* structures.
- Design *engineering* services to assist contractors.
- *Expert* *management* to insure *cost-effective* completion of each job at the *most economical* cost.

Avco / Nashville

For further information, write to:
General Marketing Manager—Structures,
Nashville Division, Avco Corporation,
Nashville, Tennessee.



This is a cut window panel for the Douglas DC-3 commercial jet.

Need glass that's stronger than some metals? Lighter than aluminum? Sensitive (or insensitive) to light, heat or electricity? Corrosion resistant, nonabsorbent, or low in contraction or expansion? These are among the many glass characteristics L O F has provided for aircraft design and safety requirements.

And as one of the world's major producers of glass, we can supply you with "grit photo-tested", top-quality glass at reasonable prices.

Aircraft Division, Dept. 2349, Libbey Owens Ford Glass Company, 608 Madison Avenue, Toledo 3, Ohio.



LIBBEY • OWENS • FORD... a Great Name in Glass

608 MADISON AVENUE, TOLEDO 3, OHIO

Creative engineering
for the space age



"Whisper" fan

Energy Designer fan

AXIAL FANS

Extensive line range of Pesc Axial Flow Fans covers most space age requirements. They can deliver from 4 cfm. Pesc "Whisper" Fan will last in space which delivers 20 cfm for quiet cooling. It is backed by 14,000,000 airfoil welded steel fan for quiet vacuum cleaner which covers all ranges.

Other Pesc fans have been custom designed for cooling electronic units, mobile support systems, aircraft propellers and helicopter engines etc.

Your project can receive a major assist from Pesc capabilities in the development of axial flow fans for diversified applications.

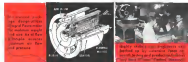
Pesc's creative engineering produces optimum designs based on the most advanced aerodynamic principles. Close internal design-production coordination means maximum performance and reliability. Integrated facilities permit delivery of prototype and production units to meet tight deadlines.

For ingenious, economical solutions to fan problems, utilize the creative engineering available at Pesc.

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BORG-WARNER CORPORATION**

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Export sales: Borg-Warner International Corporation • 20 South Wacker Ave. • Chicago 5, Ill.



What is knowmanship— and what can it do for you?

As a prime contractor, your task becomes easier—the success of your project more certain—with an assistant contractor who can fill into your "team" getting quickly and expertly. And this applies during initial planning stages—when you're first invited to bid on a major systems contract—as well as during production on the contract.

Such an assistant contractor must be heavy on specialized talents—the kind that can't be acquired overnight. His background can come only from years of experience in sub-system research, development and production. It can come only from practical experience under the Weapons System concept.

Such these indispensable assets are thoroughly covered by Eclipse-Pioneer KNOWMANSHIP—our word for the efficient combination of technical knowledge, experienced management and specialist craftsmanship that the two associate contractors must have to offer maximum value to a prime contractor.



Eclipse-Pioneer KNOWMANSHIP under the Weapons System concept dates from the very first contract of the type—in our association with General at the Air Force R-44 Interim. Here, we developed and saw supply from production Primary and Autopilot Flight Control Systems, Stability Augmentation and Control Air Thrust Systems. Another of our major sub-system contributions is to the Martin Company for Interim

Guidance, Stable Platform and associated equipment on the Army's Pershing missile.

Add to our physical resources—5,000 engineers and other highly skilled workers, 1,154,000 square feet of plant space, plus the most modern tools and equipment—and you have the sum of all total reasons why Eclipse-Pioneer KNOWMANSHIP makes such a knowledgeable partner for prime contractors on advanced aircraft and missile development and production.

A letter, wire or phone call will bring our representatives to your office with complete facts about R-44 and our de-contracting capabilities.



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APPROVED BY THE DEFENSE • SERVICE AND AERIAL OFFICERS • BRANCHES • INTERNATIONAL • QUALITY CONTROL
AND QUALITY • STABLE PLATFORMS • EXCELLENT SERVICE • HIGH AIRCRAFT PERFORMANCE AND AIRCRAFT SUPPORT

Revolutionary New Flexible Metal Hose by **BREEZE**

(PATENTED)

Withstands New Highs in Pressures, Temperatures and Vibration

Where single convolution and synthetic tubing can't do the job, this all-metal hose, formed by BREEZE exclusive DOUBLE convolution process will solve the most machining high performance problems. Here are the advanced features.

1. Excellent flow characteristics — low pressure drop.
2. Shorter bending radius — greater flexibility.
3. Double convolution design takes higher pressures, minimizes turbulence, absorbs

4. All metal, high alloy 100% stainless steel construction. Withstands high temperatures where synthetics fail.

Tell us your applications, requirements in pressures, temperatures, bend radius, inside diameters and usage (fuel, chemicals, oil, gas, etc.) We will fit this premium grade hose to your specific needs.



BREEZE

CORPORATIONS, INC.
700 LIBERTY AVE., UNION, N.J.

BREEZE PRODUCTS: ACTUATORS • HOISTS • TRANSMISSIONS • GENERATORS • STARTERS
STARTER GENERATORS • BELLOWES • SUP RINGS • HOSE CLAMPS • HITEMP FLEXIBLE TUBING
RADIO IGNITION SHIELDING • GROUND SUPPORT EQUIPMENT

Kayflex's direct drive converters translate shaft rotation into electrical and visual digital forms. These mechanically positioned units consist of coded drums, the number depending on the rate and total count. The first, or units drum, increments directly to the input shaft and rotates as the shaft turns. On models where more than one drum is used, high speed observer type gearing provides interconnections. All models can be read "on the run" or "on demand" and all tracks may produce simultaneous or serial readings, depending on the interconnector mode.

The high performance and quality of Kierulff's analog-to-digital converters are assured by rigorous testing for:

Maximal Angular Step: The location of any code transition point must fall within one-third bit of its true angular position.

Low and High Temperature: All units operate efficiently at temperatures ranging from -45° F to +140° F.

Brush Shaps: Conducted in conjunction with tests for temperature, vibration, shock and acceleration. A typical brush shap test employs 300 wsec, 30V DC amplitude 100Hz signal.

ing pulses at 1000 pulses per second. With the shaft rotating, each output drops track is monitored for a total of 500,000 pulses, in which "lost" counts or "skips" will not

Shocko Kart® racers are subjected to 18 shocks in three different planes with

Whiskers: Units must withstand vibrations between 5 and 500 cps with applied load of 100 g.

Accelerations: All units are subjected to radial accelerations of varying magnitudes up to a maximum of ≈ 7.6 g.

446a: Over 1 million lower feet (1000 hours at 60 RPH) of compressive brush travel on documented surfaces can be achieved without excessive wear in drums, bushes or other

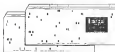
ANALOG-TO-DIGITAL CONVERTER CHARACTERISTICS									
Standard Limit	4300E-01	4300E-02	7200E-01A	7100E-01A	7200E-01A	4300E-01	7100E-01A	7200E-01A	7100E-01A
Bit of Output	8	8	10	10	10	8	8	10	10
Range	0 to 10 V	0 to 10 V	-10 to 10 V	0 to 10 V	0 to 10 V	0 to 10 V	0 to 10 V	0 to 10 V	0 to 10 V
Linearity Error (mV)	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5
Nonlinearity Error (mV)	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5
Resolution (mV)	1	1	1	1	1	1	1	1	1
Input Impedance (MΩ)	10	10	10	10	10	10	10	10	10
Input Current (nA)	10	10	10	10	10	10	10	10	10
Input Voltage (V)	0 to 10	0 to 10	0 to 10	0 to 10	0 to 10	0 to 10	0 to 10	0 to 10	0 to 10
Input Resistance (kΩ)	10	10	10	10	10	10	10	10	10
Input Capacitance (pF)	10	10	10	10	10	10	10	10	10
Offset Error (mV)	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5
Scale Error (mV)	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5
Weight (g)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum Speed (MHz)	100	100	100	100	100	100	100	100	100
Resolution (bits)	8	8	10	10	10	8	8	10	10

(1) At 25°C (Room Temperature) (2) At 0°C (Freezing Point) (3) At 50°C (Boiling Point) (4) At 100°C (Boiling Point) (5) At 150°C (Boiling Point) (6) At 200°C (Boiling Point) (7) At 250°C (Boiling Point) (8) At 300°C (Boiling Point) (9) At 350°C (Boiling Point) (10) At 400°C (Boiling Point) (11) At 450°C (Boiling Point) (12) At 500°C (Boiling Point) (13) At 550°C (Boiling Point) (14) At 600°C (Boiling Point) (15) At 650°C (Boiling Point) (16) At 700°C (Boiling Point) (17) At 750°C (Boiling Point) (18) At 800°C (Boiling Point) (19) At 850°C (Boiling Point) (20) At 900°C (Boiling Point) (21) At 950°C (Boiling Point) (22) At 1000°C (Boiling Point) (23) At 1050°C (Boiling Point) (24) At 1100°C (Boiling Point) (25) At 1150°C (Boiling Point) (26) At 1200°C (Boiling Point) (27) At 1250°C (Boiling Point) (28) At 1300°C (Boiling Point) (29) At 1350°C (Boiling Point) (30) At 1400°C (Boiling Point) (31) At 1450°C (Boiling Point) (32) At 1500°C (Boiling Point) (33) At 1550°C (Boiling Point) (34) At 1600°C (Boiling Point) (35) At 1650°C (Boiling Point) (36) At 1700°C (Boiling Point) (37) At 1750°C (Boiling Point) (38) At 1800°C (Boiling Point) (39) At 1850°C (Boiling Point) (40) At 1900°C (Boiling Point) (41) At 1950°C (Boiling Point) (42) At 2000°C (Boiling Point) (43) At 2050°C (Boiling Point) (44) At 2100°C (Boiling Point) (45) At 2150°C (Boiling Point) (46) At 2200°C (Boiling Point) (47) At 2250°C (Boiling Point) (48) At 2300°C (Boiling Point) (49) At 2350°C (Boiling Point) (50) At 2400°C (Boiling Point) (51) At 2450°C (Boiling Point) (52) At 2500°C (Boiling Point) (53) At 2550°C (Boiling Point) (54) At 2600°C (Boiling Point) (55) At 2650°C (Boiling Point) (56) At 2700°C (Boiling Point) (57) At 2750°C (Boiling Point) (58) At 2800°C (Boiling Point) (59) At 2850°C (Boiling Point) (60) At 2900°C (Boiling Point) (61) At 2950°C (Boiling Point) (62) At 3000°C (Boiling Point) (63) At 3050°C (Boiling Point) (64) At 3100°C (Boiling Point) (65) At 3150°C (Boiling Point) (66) At 3200°C (Boiling Point) (67) At 3250°C (Boiling Point) (68) At 3300°C (Boiling Point) (69) At 3350°C (Boiling Point) (70) At 3400°C (Boiling Point) (71) At 3450°C (Boiling Point) (72) At 3500°C (Boiling Point) (73) At 3550°C (Boiling Point) (74) At 3600°C (Boiling Point) (75) At 3650°C (Boiling Point) (76) At 3700°C (Boiling Point) (77) At 3750°C (Boiling Point) (78) At 3800°C (Boiling Point) (79) At 3850°C (Boiling Point) (80) At 3900°C (Boiling Point) (81) At 3950°C (Boiling Point) (82) At 4000°C (Boiling Point) (83) At 4050°C (Boiling Point) (84) At 4100°C (Boiling Point) (85) At 4150°C (Boiling Point) (86) At 4200°C (Boiling Point) (87) At 4250°C (Boiling Point) (88) At 4300°C (Boiling Point) (89) At 4350°C (Boiling Point) (90) At 4400°C (Boiling Point) (91) At 4450°C (Boiling Point) (92) At 4500°C (Boiling Point) (93) At 4550°C (Boiling Point) (94) At 4600°C (Boiling Point) (95) At 4650°C (Boiling Point) (96) At 4700°C (Boiling Point) (97) At 4750°C (Boiling Point) (98) At 4800°C (Boiling Point) (99) At 4850°C (Boiling Point) (100) At 4900°C (Boiling Point) (101) At 4950°C (Boiling Point) (102) At 5000°C (Boiling Point) (103) At 5050°C (Boiling Point) (104) At 5100°C (Boiling Point) (105) At 5150°C (Boiling Point) (106) At 5200°C (Boiling Point) (107) At 5250°C (Boiling Point) (108) At 5300°C (Boiling Point) (109) At 5350°C (Boiling Point) (110) At 5400°C (Boiling Point) (111) At 5450°C (Boiling Point) (112) At 5500°C (Boiling Point) (113) At 5550°C (Boiling Point) (114) At 5600°C (Boiling Point) (115) At 5650°C (Boiling Point) (116) At 5700°C (Boiling Point) (117) At 5750°C (Boiling Point) (118) At 5800°C (Boiling Point) (119) At 5850°C (Boiling Point) (120) At 5900°C (Boiling Point) (121) At 5950°C (Boiling Point) (122) At 6000°C (Boiling Point) (123) At 6050°C (Boiling Point) (124) At 6100°C (Boiling Point) (125) At 6150°C (Boiling Point) (126) At 6200°C (Boiling Point) (127) At 6250°C (Boiling Point) (128) At 6300°C (Boiling Point) (129) At 6350°C (Boiling Point) (130) At 6400°C (Boiling Point) (131) At 6450°C (Boiling Point) (132) At 6500°C (Boiling Point) (133) At 6550°C (Boiling Point) (134) At 6600°C (Boiling Point) (135) At 6650°C (Boiling Point) (136) At 6700°C (Boiling Point) (137) At 6750°C (Boiling Point) (138) At 6800°C (Boiling Point) (139) At 6850°C (Boiling Point) (140) At 6900°C (Boiling Point) (141) At 6950°C (Boiling Point) (142) At 7000°C (Boiling Point) (143) At 7050°C (Boiling Point) (144) At 7100°C (Boiling Point) (145) At 7150°C (Boiling Point) (146) At 7200°C (Boiling Point) (147) At 7250°C (Boiling Point) (148) At 7300°C (Boiling Point) (149) At 7350°C (Boiling Point) (150) At 7400°C (Boiling

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 • **San Francisco Office:** 1000 Market Street, Suite 1200, San Francisco, CA 94102
 • **Seattle Office:** 1000 Third Avenue, Suite 1200, Seattle, WA 98101
 • **Washington, D.C. Office:** 1000 Pennsylvania Avenue, N.E., Suite 1200, Washington, D.C. 20004

A black and white photograph of a man in a dark suit, white shirt, and dark tie. He is smiling and holding a large, rectangular xerographic print of a technical drawing. The drawing on the print shows a complex mechanical or architectural design with various lines and text. The man is standing in front of a light-colored wall. The text "XEROGRAPHIC PRINTS" is visible at the top of the print he is holding.



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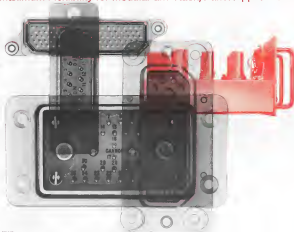
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EDITORIAL

Weapon Systems Management

The weapon system concept has been the dominant theme of military research and development for the past seven years ever since it was developed about 1952 by the then newly launched Air Research and Development Command of USAF. Since then, it has been adopted in its broad form by the Navy and, finally, by the Army, which has developed its aerial concept in the direction of weapon system development with increasing substance as industry.

It is pretty generally accepted now that the weapon system concept is the only feasible technical approach to the creation of the increasingly complex weapons of the future required by all three services. However, while that technical accuracy is conceded, there is still considerable controversy surrounding the role played by management, both military and industrial, in this process. The current Capitol Hill hearings being conducted by the House Armed Services Subcommittee headed by Rep. Edward Hebert (D-La.) are symptomatic of this controversy.

Since there have been so many popular misconceptions arising from the management aspects of the weapon system concept, we think it is an excellent idea for both the military and industry to have an opportunity to explain their positions in this area. We suspect that when the record of testimony before the subcommittee is complete, many of these misconceptions will evaporate. For example, it is widely apparent in the Congress, B-58, the first genuine weapon system development program, and in the North American B-70 and F-108 projects, representing perhaps the most advanced weapon systems now in active development, that many of the fears of subcontractors and small business proved groundless. The concentration of government funds in a few large organizations that led so widely feared by many smaller firms has certainly not materialized.

The B-58 and B-70 programs have concentrated the weapon management functions in large firms with the type of broad, overall technical capability that only the largest firms can afford. But, while concentrating system management responsibility, the procurement funds have continued to pour through the ever-broadening base of subcontractors, subcontractors, vendors and suppliers.

Testifying before the Hebert subcommittee, Lee Atwood, president of North American, pointed out that approximately 70% of all research, development and production funds expended on the B-70 and B-58 programs will go to companies other than the firm which is the weapon system manager. He estimated that essentially a total of 20,000 firms scattered throughout the country will be contributing to these programs in North America's subcontracting and suppliers structure while another 60,000 firms will be involved with the major systems developers who are working with North American on these programs (AW April 20, p. 32).

This is a message that should be given under consideration by both the military services and the corporate leaders of the weapon system management type of firm. It is equally true of the Convair B-58 and Boeing B-52 aircraft programs, the global communications system being developed under the extensive management of JTRT

and RCA and the missile program such as the Convair Altus, Martin T-45 and the Minuteman. It will apply equally well to the space exploration and operational systems now appearing in the technical spectrum.

While there is no compromise with the technical achievement that modern weapons must be developed from their inception as a complete combat ready system with all major subsystems compatible technically and properly time-phased in production, there is considerable flexibility in how the management function can be exercised over each of these new weapon systems.

In fact, the technical nature of the system under development usually requires a somewhat different management approach to meet its particular requirements.

Originally, the weapon system manager's function was delegated by the Air Force almost entirely to its prime contractor. This was the age under which the B-58 program was hatched with Convair as the prime weapon system manager responsible for delivering to USAF a complete combat-ready bombing, reconnaissance and ECM system. USAF retained only a veto power in this management, although again development was still kept out of the overall system management responsibility.

It was this approach that led to the frustrations encountered by industry people that "if USAF will tell us their targets, we will deliver the bombs on a cost plus fixed fee cost basis."

The initial system manager approach has since been modified in a variety of ways to fit the peculiar problems of each new weapon system.

For example, in the air defense arm it was deemed expedient to create a new type of organization—the MITRE Corp.—to meet the requirements of an overall system manager. Similarly, in the new global communications system under development, JTRT and RCA have been given system management functions at the executive level, while the MITRE Corp. is responsible for the program. The role of Space Technology Laboratories in the ballistic missile and space programs is another example of a different approach to the basic weapon system manager function. It is likely that these variations on the central theme of weapon systems management responsibility will continue to develop as the basic concept takes deeper root in all three military services. It also appears likely that the National Aeronautics and Space Administration will require a somewhat similar approach even for its research and development programs.

Thus, we can see development for the future the basic requirement for efficient, technically capable weapon system managers of various corporate shapes and degrees of responsibility, plan the pattern of research, development and production money spreading down through an ever-broadening base of technical and production specialist organizations whose position in this structure is dictated by the reputation of their past performance.

We recommend that the military and industry take advantage of the opportunity offered by the Hebert subcommittee to tell their agencies of their story, and follow strongly with further efforts to establish these points with the American public whose tax dollars support the entire structure.

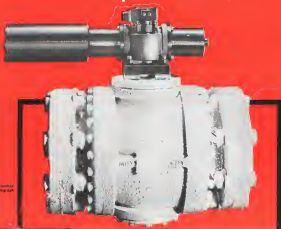
—Robert Hite

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WHO'S WHERE

In the Front Office

Dr. Walter R. Dandridge, director of engineering, Magna Vehicle Division, Bell Aircraft Corp., Buffalo, N. Y. Also, James J. Dandridge, vice president manufacturing in Bell's corporate office.

Arthur J. Osborn, president and director Lockheed Aircraft Service, Inc., Dayton, Ohio.

William S. Wheeler, a corporation vice president and general manager of Victrola Motors Electronics Division, Phoenix, Ariz. Also, Steven, former general manager of Texas, a division of Bell Aircraft Inc.

Richard S. Krenkel, Jr., president of Reynolds-Alstair Co., glass sand division of Reynolds-Alstair, Reynolds-Alstair Co., Richmond, Va.

R. E. Wren and Su Gales Gorbic, division, Bell Aircraft Corp.

Thomas H. Harney, a partner, William C. Todd Associates, New York, N. Y.

Robert F. Mendel, vice president general manager, Lockheed Products Division, West, King, Corp., Los Angeles, Calif.

Also, Frank J. Gallagher, chief manufacturing engineer; Robert P. Pette, manager manufacturing services; Arthur R. Schneider, chief engineer.

J. H. Gorbic, vice president sales and engineering, Todd Products, Inc., Phoenix, Calif.

James G. Elio, vice president electronics engineering, Conley Division, West Corp., Cincinnati, Ohio.

Clarence G. Elio, vice president and technical services, Valdes Inc., Detroit, Mich.

Caplan Hall, vice president sales, Southwestern, Arizona, Inc.

The following appointments have been made in the Bureau of Flight Standards, Federal Aviation Agency, Washington, D. C.: Chief mechanical and electrical engineer, Arthur R. Jones, chief, Kenneth A. Skopinski, deputy chief, J. Chester Spangler, chief operations branch, Jack G. Walsh, chief maintenance section, Alfred J. Newman, chief standards section. Operations Division, James W. Slips, chief, and John R. Miller, deputy chief, maintenance section, branch. Flight Management Division, Charles G. Abrams, Jr., chief navigation and standard section.

Honors and Elections

Thomas Richard Gossman, chief gas engineer of the National Dynamics & Electronics Division, has named Lockheed Aircraft Corp. a general George Mead Medal for Engineering Achievement in the development of gas for use in missiles and spacecraft.

Walter G. Lapinski, vice president traffic and sales of Pan American World Airways has been named as "Cargo Man of the Year" by the Air Freight Association, Inc. for outstanding in air cargo development.

The University of Southern California's Aviation Safety Division has been named 1954 winner of the annual Flight Safety Foundation Award. Work magazine, the long-established Service Award for promoting and enhancing safety education of aircraft.

(Continued on page 12)

INDUSTRY OBSERVER

Soviet Union has test fired several nuclear new long-range ballistic missiles equipped with nuclear warheads that could be used to destroy its targets in light and extend its range by thousands of miles, the missile. The new test missiles involve multiple stage jet engines similar to those displayed on Soviet research rockets and described in NACA research reports to 1957 (AVF No. 11, 1957, p. 20). Soviet tests were made from firing points in northeastern Russia, impacting in eastern Siberia.

First Discoverer missile to use an Atlas ICBM is a booster will be launched from USAF Naval Test Center, Cape Canaveral, Fla., rather than from Vandenberg AFB, Calif., base where Discoverer vehicles using Douglas Thor ICBM launchers have been launched.

Chapman Aerospace, a new type of device which uses, offers extremely high accuracy and long life has been developed by General Electric's Electronics Laboratories in Syracuse, N. Y. G-10, which operates at near-absolute zero temperature, has attractive possibilities for use in space vehicles.

Present schedule for two U. S. Vostok probes (AVF Feb. 23, p. 20) calls for Thor-Able IV to be fired on June 4 or 5 and Atlas Able IV, launched by Atlas booster SAC, to be fired on June 6, 7 or 8. If Thor vehicle is not fired in the first two days slated it, it will be rescheduled for June 30 or 31.

As For and Navy are working jointly on an expendable powered target drone for use with high speed aircraft. Navy has requested one project.

Reconnaissance version of its 6004th target drone is under development by Rockwell Aircraft Corp. in hopes of winning Army-Navy-McNair contract. Target version is related to current Army reconnaissance drone competition, on which the drone is expected by July 1.

Final version of USAF Capable Able D and Atlas E atmospheric nuclear ballistic missile will have an increased thrust achieved by liquid fuel flow rate in the North American Rocketdyne engines than on earlier models. D series also incorporates a glass fiber skirt around the two booster chambers. Use of glass fiber also includes some structural supports.

Scientists now working theoretically on nuclear rockets using gaseous nuclear fuel say that small scale experiments will not provide significant data and that full scale engines with combustion chambers 15 ft. in diameter and several feet long will have to be built early in one development program. Specific engine characteristics parallel with such engines are under development. Some are planned for the solid fuel heat exchanger reactors of Project Rover.

McDonnell Aircraft Corp. mockup of the Project Minotaur manned space capsule has been completed and reported by a National Aeronautics and Space Administration team. Capable contract for \$10.5 million was awarded last February.

High pressure tank of United Aircraft Corp.'s new United Research Corp., Morris Park, Calif., is to strengthen the present tank pressure in the solid propellant rocket field. General aviation of Minotaur group is to work in areas where United has not had previous experience. Chemistry is one field in this area that will be pushed hard.

New single-phase helicopter transportation project appears on the near future. The project is being coordinated by Robert's Research, Aviation College. Flight tests are scheduled shortly.

Strong interest by Rolls-Royce, Ltd., in business and military aircraft market as a source of increasing British company's efforts is noted by general aviation observers who report that the firm has been making an extensive worldwide market survey call it the most detailed that they have seen, report that the company has discussed possibility of manufacturing licenses in Britain with U. S. business plane manufacturers.



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Washington Roundup

Science Department Debate

Proposals to create a U.S. Department of Science on a cabinet level met with mixed success during hearings of the Senate Government Operations Subcommittee on Reorganization and International Department Hearings were held by subcommittee chairman Sen Robert F. Taft (R-Ohio) to obtain the views of scientists, engineers and government officials regarding the proposed legislation.

Witnesses supporting creation of such a department included Dr. Wallace R. Brode, board chairman of the American Association for the Advancement of Science; Alden H. Ames, executive secretary of the American Chemical Society; Francis R. Stoughton, president of the Engineering Joint Council; and Dr. Howard A. Meyerowitz, executive director of the Scientific Manpower Commission.

Those opposing the measure were Commerce Secretary Lewis E. Strauss and Dr. A. Stuart Dopson, of the University of California's Department of Physics. Both argued that there is no urgent need for more direct coordination of scientific activities but that it could be accomplished without creation of a Science Department.

Detection Debate

Meanwhile, the position of Dr. Herbert York, Assistant Defense Secretary for Research and Engineering, in the ballistic missile crisis warning debate has become the center of much debate in its own right.

York told a recent meeting of the American Ordnance Association that use of satellites equipped with infrared sensors to detect ballistic missiles at the instant of launch now appears to be one good solution to the problem of missile early warning. Advanced Research Projects Agency's program for such satellites is designated Project Atlas.

York said, however, that the Atlas program should not be considered as part of U.S. space program in such and should have to compete for funds with other RBM defense techniques. Some observers interpreted York's comment as an indication that he backs the Atlas approach to the current USAF concept, now under industry study, of employing airborne early warning aircraft outfitted with infrared and radar detection equipment. But others interpreted the comment to mean that York now doubts the wisdom of assigning an air mission space weapons to ABMs and believes they should be developed alongside more conventional weapons by the military services which will use them for its specific mission.

Argus Discussion

Argus high-altitude nuclear explosion experiments are scheduled to be discussed at two scientific sessions of the National Academy of Sciences (one on Wednesday Symposium on Scientific Effects of Airfields), Joint-Defense Radiation at High Altitudes is scheduled for 8 a.m. to the last of four symposiums at the Academy's 86th annual meeting. Participants are Richard W. Proulx, of General Electric, chairman; Nicholas Christofilos, University of California; James A. Van Allen, Goddard Space Flight Center; George H. Ludwig, of the State University of Iowa; May Lee Allen Jr., and Capt. Joseph A. Welch, Jr., USAF's Air Research and Development Command's Special Weapons Center; Philip Newman, of ARDC's Chemical Research Center; and Allen M.

Peterson of Stanford University and Stanford Research Institute.

Second meeting involving Argus will be the opening session of a four-day symposium on Problems of Space Exploration sponsored by the Academy, the American Physical Society, and the National Aeronautics and Space Administration. It is scheduled for 1-10 June Wednesday at the Academy. Chairman is Bruno Rossi of Massachusetts Institute of Technology. Papers will be given by Paul E. Whipple, of the Smithsonian Astrophysical Observatory; Thomas Gold of Harvard College Observatory; Eugene N. Parker of the Enrico Fermi Institute of Nuclear Studies, University of Chicago; and by Van Allen and Christofilos.

A round table discussion, chaired by John A. Simpson of the Air Force Research Office, will include S. R. Hobbie and Dr. Robert Johnson, head of NASA's Theoretical Division.

Appointment Confirmed

Richard E. Homer last week officially assumed as Assistant Secretary of the Air Force for Research and Development effective June 1, to become Associate Administrator of National Aeronautics and Space Administration a post he published in Aviation Week (April 20 p. 75). Homer will be responsible for general supervision of NASA operations under Deputy Administrator for Hugh L. Dryden at a salary of \$21,000. His successor, probably USAF chief scientist Dr. Joseph V. Chertok, for the Air Force job had not been formally named as of late last week.

Flight Pay Savings

Defense Department estimates that a new audit tightening "pilot pay" being by desk officers (AW April 16, p. 25) will eventually save \$10 million a year. Brig. Gen. R. J. Fenderson, USAF Budget Director, estimates that the annual fuel bill for pilot pay during the Air Force is now \$10 million.

Capital Elections

Two major stockholders of Capital Airlines have been elected to top-level positions by the company board of directors. George H. Allen, who has been closely associated with the company for over 30 years and who owned 45,832 shares of common stock, as of last Dec. 31, was named chairman of the board, a position that had been vacant when J. H. Christofilos, now president of Fairchild, resigned last year. Charles F. Newkome, a partner in the legal firm representing the airline at general counsel and owner of 75,172 shares of common stock as of Dec. 31, was named chairman of the board's executive committee. In the past year, Newkome has received his holdings from the 15,882 shares of common stock he acquired in the Civil Aeronautics Board for the year ending Dec. 31, 1957.

Renegotiation

House President William M. Allen will be the first negotiator, spokesman this week on proposed extension of the renegotiation law at hearings of the House Ways and Means Committee. Committee expects to complete public sessions in three days.

—Washington staff

USAF Considering Moon Base by 1968

Industry members brief Ballistic Missile Division on operational requirements of earth-moon-earth trip.

Washington—United States Air Force is weighing operational factors involved in establishing a base on the moon by 1968. Air Research and Development Command's Ballistic Missile Division, Langley-Hall, Va., was briefed recently by industry members on broad requirements for earth launch, ascent orbit landing, operations on lunar landscape and return to earth.

Presentations described how fast data and was made under ARDC's Systems Requirement 153 which encompasses establishment of a lunar observation base. One of the requirements which is essential on military intelligence interests, as needed in moon reconnaissance, was advanced knowledge of SR 152, related to earlier bombardment re-taliation capability, from a moon base. State military observers feel that our capabilities should be put directly on SR 152. They reason that if the gigantic effort and expenditure required to establish a moon base is going to be supported, the result should embody the added potential of bombardment capability.

An interim report on SR 152 will be made the summer of ARDC had gotten by at least three industry sources who hold study contracts, and results by other companies which are handling their own studies under SR 152. At completion of the study, representatives of Air Force Research Projects Agency and National Aeronautics and Space Administration also are scheduled to sit in on the final presentation.

Peaceful Use

Industry men feel that the general subject of lunar base is being placed down because of the Soviet threat. They reportedly attribute to genuine peaceful use of outer space. Industry observers feel, however, that in view of the difficulty of negotiating with the Soviets on a cordial basis, the work, at a minimum, to ensure that any specific, international agreement could be reached with regard to the sanctification of space exploration. These observers feel that technology involved in moon base operations should be pulled, because this same effort is being advanced by Russia.

During on SR 153 given by industry members was in the nature of a progress report, since final proposals are scheduled somewhat down the line.

Government agencies which had participated at the briefing included: •USAF's Office of Advanced Technology, headed by Brig. Gen. H. H. Roush, Jr., director of advanced tech-

nology, deputy chief of staff for development; Gen. Beecher has been a frequent spokesman for the feasibility of military bases on the moon.

- Ballistic Missile Division, ARDC
- Ballistic Missile Center, Air Materiel Command
- Wright Air Development Center, ARDC
- Strategic Air Command
- National Aeronautics and Space Administration
- Jet Propulsion Laboratory, NASA
- Military Academy, participating in the briefing included:
- Boeing Aerospace Co.
- Republic Aviation Corp.
- Douglas Aircraft Co.
- North American Aviation Co., Inc.
- North American Aviation's Rocket Division
- United Aircraft Corp.'s Missile and Space Division
- General Electric Co.
- Mississippi Research

Two of these companies are expected to have Air Force contracts for SR 153 study. One does not compete for other industry contracts are supported by company funds.

Presentations under SR 153 was a mixture of specifics, theories, opinions and promises. Most optimistic talk was toward mechanical developments, while most pessimistic views were toward with respect to bombardment aspects, particularly as related to sustaining lunar bases in the hostile lunar environment.

An Air Force technical team are aware of a capability shortage to keep up with their new responsibilities in the space regime. One medical participant in the SR 153 briefing declared that until recently there had been enough available specialists in the Air Force to handle the immense problems of earth atmosphere environment but that those problems had grown at a fast pace, outstripping the increase in the number of medical personnel required to keep abreast of the state of the art.

Those with final administration by industry members that part of the response would be colored—perhaps on the side of what they feel for the complete earth system to establish a base

base. They admitted it would have to be pointed by distant need for the use of the base—either in retaliation or as a force.

Value of the base as a communications station was considered, particularly with respect to positioning of the base earth would present reasonable viewing per day and per year. Studies under SR 153, which was in effect foundation, conclusions, are slated to complete all methods of surveillance—again in lunar orbit and other procedures. Other aren't viewed too favorably because of cloud cover interference.

Also, weight of the optical system for viewing the earth would scale a very high figure, with knowledge of the satellite probably transported and stored and assembled into a composite system. Indeed viewing is considered better than optics but even the method would have to be done in the way of specific detection results through cloud cover. Some participants feel that relatively low altitude orbit this would be a better investment.

Moon Vehicle

Proposed details at the briefing included: •How, by what means

- Vehicle for the lunar mission was in concept to accommodate up to 10 persons.

•For the trip out, probably four stages of propulsion will be required, and probably two stages for return from the moon, carrying a total of six stages.

•One lunar vehicle was envisaged, a cluster of broad-based propellers capable of capturing 10,000,000 ft. thrust. Four logistic support required to fuel these rockets for takeoff was performed as a transportation task. Aviation propulsion was used as a huge cluster of solid propellant motors for booster service.

Nuclear propulsion in the form of a single stage for the return journey also was proposed, but for a later opportunity date than 1968.

•Estimates of lunar weights of the lunar vehicle varied from about 5,000,000 lb. up.

•Individual propulsion systems to propel spacecraft from the lunar landscape also was considered as a possibility which might be necessary in case with lunar surface phenomena in the event the dust layer was too soft and deep to permit normal landing.

•Crude rocket engines to the moon varied, with 20 days of air offered as a representative figure.

While detailed system design and hardware projections were specified, some military observers at the briefing were skeptical of what they considered just answers to various problems. For

example, one item which was considered to be treated too lightly was a spare set provided to be used on the moon. This type of guarantee, some observers felt, would require considerable research and development before such was definitely insured.

One point of considerable controversy was related to protection of people on the moon when vehicle in the event it should land over hostile territory on earth.

This was stated by one of the briefing as a prime example of impractical detail for a situation about which very little could be done.

One industry representative felt that while some preliminary design details were pointed in the moon base studies, too much emphasis was being placed on specifics and not enough on the approach looking to the accomplish-

ment of a mission which was considered to be treated too lightly was a spare set provided to be used on the moon.

Factors considered necessary in the category of basic information include moon rotation level, frequency of meteoroids, surface dust composition and depth, and whether gases vented from moon surface would be harmful or useful. Another factor seen affecting cost and effort for base establishment is whether shelters could be erected above ground or underground.

Impending engine's needs, followed by other modernizing parts, the reason to pick up and compile the design from up by the engine, the following results, in one projection seen as reducing a possibility of determining lunar surface composition. Radar reflection tests also are seen as a means of retaining lunar landscape records.

Despite all the problems which

would have to be solved and the tremendous cost involved in establishing a lunar base, opinion was firm among participants that if the project were going to be supported, it would be necessary to channel sufficient effort into the present state, if a relative dire of stagnation was to be averted.

Previously, a presentation on feasibility of establishing a lunar base was given last September before Advanced Research Projects Agency in Washington. The presentation consisted of a fairly detailed analysis of velocities required to get from earth and moon to one another, propulsion requirements, vehicle weight, cost for logistic transport vehicles, and moon-to-earth bombardment capability. The program suggested that a base probably could be established by 1965 if sufficient support was available.



DASSAULT Mirage 4 Mach 2 fighter is powered by two SNECMA Atar 9 turbojet engines. The aircraft weighs a 30,000 lbs. The Dassault Mirage 4 has a top speed of 2,000 mph. Mach 3 bomber with 1,250,125 hp. engine. Engines probably will be Fiat & Whitney J75 engines built by SNECMA under license (AW Feb 5, p. 25).

French Plan Aviation Future

Paris—French Air Ministry has long-range program covering transition from glibed jets to missile carriers as one of the Sud Aviation Suezair tactical missile and a 2,000 mi. French designed intermediate range ballistic missile, with Dassault Mirage, is becoming the last planned bomber built in France (AW May 8, p. 27).

Gen. Louis Roze, Minister of Defense and Minister of Air, said that these projects are far ahead by French Assembly.

•**Suez**—Smaller, ground-to-ground weapon being tested in Algeria.

•**Dassault** Mirage 4—jet fighters and fighters 11,500 km/hour (7,000 mph) subsonic for the French total air arm.

•**Dassault** Mirage 3—Figma (Mach 2) jet fighter, Nord Noratlas transport, and Mirage 5—jet fighter, possibly powered by Pratt & Whitney J75 jet engines built under license by SNECMA.

production version of Mirage 4 and a twin-engine, canard, supersonic aircraft and either the Sud Vautour 117 or Dassault Commande 015.

Sud now is undergoing work of the Vautour, following in flight tests of a prototype section which included a crash test in France, and the time he may sit in Dassault's twin-engine, canard, supersonic aircraft and either the Sud Vautour 117 or Dassault Commande 015.

Gen. Roze and the long-range civil transport, which includes design and construction of a Super Canard, a twin-engine, canard, supersonic aircraft, powered by two General Electric T58 jet engines and featuring boundary layer control.

Ministry declined to give schedule or even involved in the program. Sources indicated the Ministry is pending to get the program accepted by the French Assembly this summer.

No further details on the Vautour, which was given, but based on the Sud Vautour 117 or Dassault Commande 015.

All these French aircraft will be supplied with Sid Aviation Model 1500 triple turbofan turbo-propeller under the Ministry plan.

Production of military aircraft for export also figures in the program. In total, the Dassault Mirage 1650 turbo-propeller, canard, supersonic aircraft, the Dassault 4M and the three or four aircraft now in production.

No military production would center on the Sud Canard, the Sid Vautour, Super Canard, nor transport and the Dassault 4M transport, powered by two General Electric T58 jet engines and featuring boundary layer control.

Bids Readied for ARPA Satellite Designs

By Philip J. Klaus

Washington—Several design papers are expected to bid this week for design of the first of three basic types of active communication satellites to be developed by Defense Department's Advanced Research Projects Agency. Available for two other types of communication satellites are expected within several months.

The three types of communication satellites, which promise major improvement in long-distance military communications, include:

- **Delayed relay, known as Project Conquest**, a 500 lb satellite which can carry 20-100 independent radio channels between two or more earth stations. The delayed relay satellite, a more sophisticated version of the Project Scout relaying satellite launched last December, receives a message by radio from one earth station, records it on tape, then retransmits it when the satellite passes over and is retransmitted in an overhead station in some other part of the globe. First model, which lacks an on-board clock, is slated for launching in 12 to 18 months.

- **Following midline repeater**, a 600 lb satellite designed to be placed in a 22,400-mi equatorial orbit so that it remains in fixed position relative to earth, will be able to instantaneously and continuously retransmit radio-telephone messages received from one earth station to another. Satellite is to have the capacity for 144 two-way channels in several thousand telephone channels. Thus, such satellites, equally spaced in equatorial orbit, can provide a world-

wide communications network with two points on the earth exposed for the area above 80 deg latitude. ARPA's timetable calls for selected bids on major satellite components and techniques in about 18 months, with a complete, operational launching satellite in orbit in three to four years.

- **Polar midline repeater**, a 450 lb satellite which functions similarly to the equatorial repeater type, will be placed in a lower-orbital polar orbit to fill in the high latitude gap in coverage of the following satellites. The polar repeater is expected to be a great boon to USAF's Strategic Air Command, whose bastions must now rely upon high frequency (HF) radio which is frequently disrupted in the Arctic by atmospheric disturbances. By providing direct ground-to-satellite-to-aircraft communications in the ultra high-frequency (UHF) band which is not affected by such disturbances, ARPA hopes to launch a prototype of its first polar midline repeater satellite in 18 to 24 months and have in operational orbit in orbit in approximately three years.

Responsible Agencies

Responsibility for developing new active communication satellites and associated launching vehicles and ground stations has been assigned as follows:

- **Delayed relay satellite** (known as Project Laboratory II) Mission, N.Y., will develop satellite ground station and is associated tracking antenna with USAF's Bellmont Missile Division responsible for booster upper stages and guidance.

Many times 40 computers in a single month's production testing across half

by the Signal Corps and more, then half of these indicated an intention to submit proposals which are due this week.

- **Following operational repeater satellite**, Army Signal Laboratories and Air Force, Ballistic Missile Division also share similar responsibilities for this project because of the greatly increased complexity of satellite acoustic equipment, launch, guidance, and stabilization problems, initial contracts will cover research and development of basic techniques and components which then will set the design of the complete system. Subsequent contracts probably will not be awarded for another year or longer.

- **Polar equator satellite**, Although a firm decision has not yet been made, USAF's Ballistic Missile Division's plans likely to lead the program. Wright Air Development Center's Communications & Navigation Laboratory will handle the satellite basic mission and a special satellite antenna is geared for ground-to-aircraft-to-satellite communications. Preliminary bidding for prospective contractors may be held within 60 days.

Operational version of the course (Advanced relay) satellite will be placed in a middle equatorial orbit at an altitude of approximately 1,200 mi, according to present plans. However, this is quite a difficult design problem because of the ionospheric effects when fired from Atlantic or Pacific missile test ranges. Because of this, ARPA probably will settle for an orbital orbit of 900 to 1,000 mi for the first prototype model.

Satellite radio frequency receiver will operate in the intermediate region (probably 1,000 to 2,000 mc). Output

from the transmitter will be a few watts. Electric power will come from solar cells and rechargeable batteries, enabling the satellite to transmit in any light or darkness. Antenna will be positioned around the outer surface of the satellite to avoid the necessity of adjusting satellite attitude with respect to earth stations.

Redundancy in the form of dual or triple elements will be used through the acoustic equipment to assure continuous reliability in this and other communication satellites.

In the event of failure, the earth station will be able to switch to a standby element by radio control, according to present plans.

To provide intercontinental or transoceanic communication of the major satellite, transmitter by unpowered station, deploying the batteries and causing the satellite to lose its voice over radiated stations, moderately sophisticated security techniques will be employed in acoustic equipment design. Where privacy is required, messages sent to the satellite for relay should be coded.

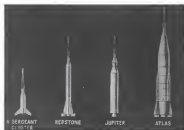
The inherent delay in message transmission by a counter-type satellite suggests that this type will be used for routine military messages and logistics traffic. More urgent messages will go by fast, free-type repeater satellite.

Hovering Repeater

A hovering midline repeater satellite poses more difficult design problems than the counter-type, but offers superior advantages since that problem is not of the nature, operation of a hovering satellite into orbit will require extremely precise guidance and control. Once in orbit, small changes in orbit will cause the satellite to drift in one or other means, may be needed to keep its position fixed relative to the earth. But once this is accomplished, the need for any movable antenna on the earth to track a hovering satellite will be eliminated. This will permit use of large, high-gain antennas which allow reduction in power of the satellite transmitter.

The hovering type satellite can provide instantaneous continuous communications between any two points on the earth (below 80 deg latitude) over distances of approximately 3,000 mi. But continuous operation with present payload limits means the problem of providing adequate electric power around the satellite.

To increase the power level of the satellite transmitter, ARPA plans to use high-gain dish-shaped antennas on the earth. But this requires that the satellite be able to be positioned so that the antenna always points toward earth. Also, only orbit in a hovering satellite must be able to continuously position



Project Mercury Test Vehicles

Test vehicles for Mercury manned vehicle are, from left: Little Joe, Redstone, Jupiter, Atlas. Plans will send Redstone on suborbital flight, Atlas for orbit (XIV April 28, p. 28)

themselves toward the sun. Since a hovering satellite is visible from so large a portion of the earth's surface, it is vulnerable to jamming by anyone in that large area. (The counter-type can be jammed only at the vicinity of a fixed station when its waves are transmitted to earth.)

ARPA is planning on duplex operation for its hovering satellite, i.e., simultaneous transmission and reception at different frequencies. Operating frequency also will be in the microwave region.

Study of anti-jamming techniques for satellite use will be one of the major areas to be investigated by the Signal Corps and its contractors under awards to be made within the next future. Other problem areas to be investigated by Army, and by the Air Force, include possible relay configurations, atmospheric and attitude stabilization, frequency stability and reliability. ARPA has set a goal of one year's operating life for satellite relays.

This polar orbit repeater satellite, in a more respects, a simplified version of the hovering repeater. One difference is that it will transmit and receive in the ultra high frequency (UHF) band. This will permit smaller satellite communication with existing UHF communication equipment now installed on military aircraft. A special steerable antenna for tracking the satellite will have to be added to the airplane, however.

The polar repeater also will employ directional antennas which must be kept actively oriented relative to the earth. Position of station keeping will be somewhat less severe than for the

hovering satellite. Relative positions of repeater satellites in their polar orbit must be established, and maintained such that at least one is always visible to earth stations and to aircraft, able to report on ships operating in the Arctic or Antarctic.

If the position of each polar repeater can be established accurately in ground, a test of four should provide full global coverage. If not, additional satellites will be required to assure that one is always in view.

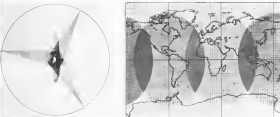
Jamming also will present a problem for the polar repeater satellite. Although voice communication is preferable for security, coded data links may be used because it is less susceptible to passive communications.

Initial prototype of the polar repeater is scheduled to be launched in about 18 to 24 months, with a full operational system in orbit within four to five years.

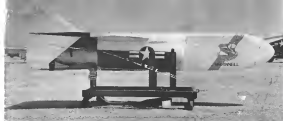
The Future

In doing the larger booster program now under development, ARPA has long-range plan for a communication satellite weighing 10,000 lb. The added payload would permit use of higher power transmitters, greater bandwidths for transmitting more sensitive information and greater concentration in one area design for improved reliability. More sophisticated anti-jam features also can be included.

Both ARPA and the National Aeronautics and Space Administration are working in the field of communication satellites. ARPA currently is placing emphasis upon active types which carry acoustic equipment aboard; NASA is



COMBINATION of three hovering satellite repeater stations, in equatorial orbit, will be able to cover entire globe, as shown in right. Coverage area obtained from three hovering satellites alone, with high latitude gap, is shown at right.



Quail Decoy Wing, Fins Fold for Storage in B-52

Design details of McDonnell's GAM-70 Quail decoy missile, including how the truncated delta wing and fin fold into the missile body (below, right) were shown in this display at the World Congress of Ships at San Juan, N.Y. The top surface of the fold outward toward the tip and left surface for fin moved. Details for the General Electric J65 turbo jet engine with ramp and airframe shown are shown (top, and below, left).



working with a permit type consisting of a large inflatable aluminum control plastic sphere which reflects radio signals back to earth.

Paul A. Price, who heads ARPA's communication satellite and tracking efforts, says that there has been activity between the two agencies in his field. ARPA is moving to apply the existing rules of the art to find vehicles suitable for military use, while NASA, doing advanced, basic propagation and wave effects, "regard this as a great approach."

The present activity/purpose line of demarcation is not a rigid one. NASA Administrator Keith Glennan said at recent congressional testimony that his agency planned to investigate active

communication satellites for possible commercial (civil) applications. Similarly, ARPA is thinking about the possibility of passive satellites equipped with wideband flatplate reflectors since it has solved the satellite attitude attitude problem. ARPA also may investigate the possibility of placing thousands of tiny aerial pellets into orbit to serve as a passive reflector of radio waves.

Present communication satellite program management philosophy at ARPA is that it is not necessary to give complete project responsibility to a single agency to assure adequate coordination, except where the satellite and launching vehicle guidance or evaluation are financially related. This explains why or-

possibility for launching the vehicle has been delayed in one service, the satellite is evident, in two of the other programs to date.

Price recognizes that close liaison is required for all satellite programs and points out that the Air Force Ballistic Missile Division has been stationed at Army Signal Laboratories and vice versa to assure the required coordination and integration.

Army Signal Laboratories subcontracted tests and success of its Project Snow falling satellite mission, then assembled the elements staff. For the forthcoming remote satellite program, however, a single contract is expected to be awarded for the complete satellite package.

Gross Details Lockheed Expansion Plans

By Katherine Johnson

Washington—Robert E. Gross, head chairman and chief executive officer of Lockheed Aircraft Corp., outlined Lockheed's plans last week for expanding into new aircraft fields and for building the technical competence needed to sustain its position as a military weapons system designer.

Gross followed J. L. Almond, president of North American Aviation, Inc. (AAW April 20, p. 11), as a witness at hearings of the House Armed Services Subcommittee on Research, Development, and Test.

Gross followed J. L. Almond, president of North American Aviation, Inc. (AAW April 20, p. 11), as a witness at hearings of the House Armed Services Subcommittee on Research, Development, and Test.

Growth Rate Target

Gross told the subcommittee that Lockheed's "assessable target" is a growth rate of 5% a year, the average rate of sales growth of the 50 largest industrial companies over the past 10 years.

In order to maintain its present position as the company, Gross pointed out, Lockheed must at least parallel that of the gross national product, which is increasing at a rate of about 3.25% a year.

The Lockheed executive noted that the possibility of accomplishing the with additional military business. He said Lockheed studies indicate that its basic expenditures will increase a minimum 2.75% a year. "And, of course, with new decisions in international business, it is almost possible that these expenditures may double," he added.

"In any event, we cannot reasonably expect to give for ourselves a greater share of this defense market. Our present share is about 7%, and we are in line in view of our past successes, regional and community pressures and the highly competitive nature of the business, that we cannot significantly increase this figure."

"The alternative is to broaden into non-defense work."

In this direction, Gross pointed out that Lockheed has already taken these steps toward expansion.

By month—CL-402, CL-403 and CL-404—were out an agreement to produce a controlling interest in Pacific Island Design and Drilling Co. of Seattle, a West Coast geophysical and construction firm (AAW April 6, p. 57).

Aircraft major ship aircraft, taken by Lockheed-establishment of an Electronics and Avionics Division—a aimed at expanding the firm's weapon system components, as well as developing new products, military and industrial, Gross said.

He also told the subcommittee that the new division will have less than 12 employees.

Its first assignment is "to exploit two or three small products that we have developed that might have broad application."

As weapon complexity increases, Gross pointed out, the system manager must develop managerial skills to meet the complex problems of selling all the parts to the whole and of supervising an ever-increasing volume and variety of work.

In the defense work program, Gross said, Lockheed is pursuing Gross said that, although the new weapon would cost about \$5 million, as plus to build with about 15 million worth machines. Nevertheless, he said, he is unable to provide management control over the whole. He added that, "We have got to have more competence than we now have to manage a world-wide aerospace defense system." Lockheed has already spent \$100,000 on studies and is now planning to develop and build a development system, Gross reported.

Mercury Roles

Washington—Negotiations concerning the division of assignments in National Aeronautics and Space Administration's Project Mercury man-orbit program were still under way last week, according to NASA, Air Force's Ballistic Missile Division and Space Technology Laboratories, Inc.

Space Technology Laboratories will have responsibility for various engineering and technical details of the Mercury project as reported by Aviation Week (April 13, p. 21), although it may have the management for some parts of the launch and test launch trajectory phase.

NASA plans to use at least 10 Atlas boosters in the Mercury program. It is ordering these through the Ballistic Missile Division. Two contracts to BMD which amount to transfer of NASA funds, have been awarded for two—one for \$14 million and the other for \$16 million.

adding that there are at least half a dozen other industrial firms in the race.

Gross said that, although only big business can compete for weapon systems contracts, the industry must cooperate within the industry, and "many companies will be its wounds."

He added:

"One of the difficulties now is the traditional small-business industry now being in the competition of the big business from other fields that are cash-rich and looking to establish their status in research and transfer."

Why Diversity?

If these companies believe they can best be met at our own field, they're entitled to the chance. We ask the same opportunity to expand and diversify ourselves."

"One of the reasons why we are attempting to broaden and deepen our strength. We are trying to qualify ourselves to meet the new competitors and to handle ever larger, ever more complicated orders."

"One of the reasons why we are attempting to broaden and deepen our strength. We are trying to qualify ourselves to meet the new competitors and to handle ever larger, ever more complicated orders."

The Navy found that with many modifications the Ektas became a true submersible patrol aircraft. And we are offering both plans to perform other important military missions. In these cases there is no reimbursement of our development cost except as they are included in an off-the-shelf delivery, price and borne by both our navy and commercial customers."

Polaris Development

To illustrate the new competition develops and the extent to which it represents a system of management, Gross detailed development of the Polaris sub-surface fleet ballistic missile program.

• New agreement in December, 1955 that it was intended in a fleet ballistic missile with a 1,500-mile range. At that time, it was to have been a surface-to-surface missile, ship-launched and liquid-propelled to be developed in cooperation with the Army Pacific and Navy, using Jupiter components and systems.

• Early in 1956, Navy rejected liquid fuel as unsuitable for high-speed use. "By the year this, the surface of a totally new concept was beginning to appear—the possibilities of a missile."

Boeing-Wichita Aims at Advanced Design to Develop Own Business

Wichita—Needle a state of projects, Boeing not only its traditional relationship with the U.S. Air Force, but also the Army and Navy, are on the drawing boards of a new, advanced design team here, as Boeing Airplane Co.'s Wichita Division mounts itself towards self-sufficiency.

A Boeing management program geared to the realization that the aircraft industry is living through a transitional period of its total effort will be devoted to production of aircraft work, although advanced design to such of the manufacturer's advantage. Boeing President William M. Allen has told the Wichita Division that it holds its future in its own hands and is responsible for developing its own new business.

The Wichita Division charter calls out three new roles and missions.

- Management of B-52 and B-47 programs
- Continued naval aircraft
- Military utility aircraft and commercial derivatives other than for the airlines (latter being in the province of the Transport Division at Renton, Wash.) One study modification for the Army's interim tank has been design of a Douglas DC-7 capacity tank wing wing housing, winging a SIGC transport for battlefield air support.

To provide national manpower needed to handle these missions, Boeing Wichita split the advanced design department from its technical staff section and moved it into completely re-located quarters in company-owned Plant No. 1 which the program is managed by William J. Frank. Since its formation last year with a nucleus of 51 employees, the section has grown steadily doubled its personnel.

Each of the three services has its own system managers, and they share in a staff for design analysis, management, review and administration functions. Programs for each of the services are set up under a program manager who pulls together a group of two to 10 persons for the life of a particular project.

Prime program taking the lead, of present, is redesign of the B-72's

production line. USAF system manager currently has some five programs involving advanced versions of the B-72. In scaling out into B-72 development, advanced design section is permitted to tap skills in the other Boeing divisions in order to work out a complete weapons system proposal, or an entire aircraft as a proposal.

In the case of a new project to develop the airplane, a single platform for the program is represented as for the purpose of subcontracting in general. The aircraft design section would work out the basic requirements for the system. In the case of this work, the project would go to Hughes Aircraft Division, which would have right of first refusal to handle this portion of the project. General land air craft divisions, then, would contribute their work with the Boeing team handling advanced aircraft system for a particular design covering such a mission.

Regular progress reports are made to Boeing headquarters. There are monthly sales engineering and management meetings at which William J. Frank reports progress, is responsible. Considerable coordination of various design projects is required to ensure that they do not inadvertently conflict when proposals are submitted.

NASA Announces Space Contract Awards

Washington—National Aeronautics and Space Administration has obligated over \$10 million for study on a broad variety of concepts involving \$140,000 for initial studies and final design demonstration for the Project Titan design to launch a technological satellite in space, the satellite being energy and life observation facilities of the dual orbit (AW April 25, p. 28). From contract was awarded to Aero Space Corp.

Other projects involved are:

- General Electric Co., \$4.12 million for the Project Vega second stage rocket engine, which will be developed in a General Electric model to lead two test units orbit.

- NASA Jet Propulsion Laboratory, \$3 million for technical supervisor integration and guidance for Project Vega
- Bell Aircraft Corp., \$1.07 million for hardware and studies to determine feasibility of rocket engine using fluorine and liquid oxygen propellant
- North American Aviation, Inc., \$718,000 for detailed system and design of ground support transport vehicles and

launcher for Project Victory second stage program

- Naval Research Laboratory, \$260,000 for advanced test equipment
- U.S. Weather Bureau, \$140,000 for meteorological analysis
- Elmer Medical Research, Inc., \$170,000 for supplying two aircraft systems to build Victory program
- Aero Ordnance Master Command, \$100,000 to reimburse that agency for special technical studies and activities
- U.S. Naval Ordnance Test Station, \$100,000 for research and development of sub-orbital space television camera
- United Chemical Co., \$90,000 for remote control motor in high-orbit work at Lewis Research Center
- Radioplane Division of Northrup Corp., \$40,000 for a landing and recovery vehicle for the Victory program
- Cook Electric Co., \$90,000 for five thermal sensitive electronic tape recorder for use in various projects
- Hercules Inc., Johnson, Inc., \$70,000 for a 1,600-gal. liquid hydrogen tank to be used in support of rocket development work at Lewis Research Center
- U.S. Army Ordnance and Concept Development Co., \$20,000 for two stage Nike-885 sounding rocket

British Studying Satellite Proposals

London—British government is studying proposals for six earth satellite projects. The decision as whether to go ahead with such a program will be announced as soon as possible, according to Ministry of Supply, White Paper.

Any British space project probably would be based on the use of the Blue Streak and Black Knight rockets.

Britain's space agency probably would be involved in cooperation with other Commonwealth countries. Advice on the proposal for a British satellite program was sought from the Advisory Council on Scientific Policy, which made a report to the government. Consultation has not been received.

The decision probably will be announced well before the meetings of the Commonwealth Spaceflight Symposium and the Fourth Congress of the International Astronautical Federation to be held in London in August and may come in early in five months.

There is considerable feeling in some government circles that, despite the cost, Britain must accept or later enter the space field and that the nation's visit it made the better.

That this feeling is not shared by all was made clear by Socialist Member Edmund Stanbury when he asked the House of Commons, why bother about the problem? He suggested Britain has sufficient problems on earth without looking elsewhere.

NORTH AMERICAN NAMES SUNOSTRAND SECONDARY POWER SUBSYSTEM MANAGER ON B-70 AND F-108

Sundstrand Aviation is proud to be named a member of the North American weapon system team which will develop and produce a new concept in American air power—planes which will roam the skies at three times the speed of sound and feature the capabilities of both attack and manned aircraft.

To meet its vast responsibility as a major system contractor for the B-70 Valkyrie intercontinental bomber and F-108 long-range interceptor, Sundstrand's system organization will include its own team of subcontractors—component suppliers and manufacturers whose reputation for technical skill, product development, quality, and reliability make them outstanding in their fields.

Utilizing the team concept with its subcontractors, Sundstrand provides the most efficient and effective means of accomplishing its assigned responsibility—development and production of reliable Secondary Power Systems for the B-70 and F-108.

SUNOSTRAND AVIATION

Subsidiary Sundstrand Machine Tool Company 2411 Broadway, South Portland, Me.

Denver Office: 1401 Arapahoe, Denver, Colorado
 Los Angeles Office: 10000 Wilshire, Los Angeles, California
 Bedford Office: 1000 Wilshire, Bedford, Connecticut
 Washington Office: 1000 Wilshire, Washington, D.C.

Scout Contract

Washington—Chrysler-Vought Aircraft, Inc., has won a \$145,000 contract to build the engines, controls and build a booster for the Project Scout rocket test vehicle for Naval Aeronautics and Space Administration. Thirteen companies bid in the competition. Award test design are expected in mid-1966.

Leader in Secondary Power

SUNOSTRAND

SUNOSTRAND AVIATION

Fairchild Tightens Central Control

New York—Fairchild Engine & Airplane Co. is changing its management practices away from intense decentralization and attempting to improve its engineering operations to cope with a situation that led to a \$17 million loss last year and \$277,000 loss the first quarter of this year, stockholders were told here last week.

Revealing working sales of the company's F47 turboprop transport (AW April 15, p. 126), President J. H. Carmichael said, the company is looking at several advanced design projects and is exploring previously unexplored fields for work to offset its excess capacity. On a square foot-per-employee basis, Fairchild was operating at 75% capacity in 1958 and dropped to 50% this year, Carmichael said.

Fairchild has \$122 million in orders the president said, and the company probably will make a small profit for the year. However, if the company loses even a small portion of the business it now has, he said, profits will be small. The first quarter loss was largely due to approximately 550,000 in expenses in shutting down the company's Dear Park, N. Y., engine plant following the 151 delivery cancellations.

Monitors taken by company include:

- Reduction of executive salaries on a total basis of 10 1/2%. Carmichael is being paid \$79,000, equipped with \$116,000 monthly paid to Richard S. Howie, senior president. William L. Landers, vice president, has taken a voluntary reduction from \$75,000 to \$60,000, stockholders were told.

Since criticism was voiced by stockholders of previous payments continuing to Howie which amount to \$91,527,525,545, depending on how paid and an additional \$10,000 a year to be paid through 1963. The company, as revealed that these payments were from funds previously set aside for first and second year cost of research funds.

- Reduction of 1,089 employees in the company's newly consolidated Modules and Aircraft Division.

- Reorganization of the management structure to lower division managers independent, but greatly improving management responsibility.
- Improvement of cost control so that control, perhaps daily, figures are available on every program to keep programs from getting out of hand.
- Improvement of public relations and community relations, attending rallies and not increasing the company's problems.

In this connection, Fairchild said the company also had improved its relationship with its banks, a point noted by Bankers Trust Co. of New York. It is understood these had deteriorated because of conflicts over information dealing with the company's affairs.

Reference to Fairchild includes sale of the Dear Park engine plant, which Carmichael said, was currently in the negotiation stage. Not a much progress has been made, he said, in sale of the company's former headquarters building at Hightstown, N.J.

Initial F-27 results have been good, Carmichael said, although there have been a few bugs in the airplane. Some of these are similar those with which Fairchild is not satisfied and some are design engineering, in the air conditioning and nose wheel steering. From these are solved, Carmichael said, and the company is almost certain with them on a production basis.

Aeronutronic Awarded Army Missile Contract

Los Angeles—Aurora's \$23 million Skyhawk surface-to-air missile development project has been awarded to Ford Motor Co.'s West Coast subsidiary, Aeronutronic Systems, Inc., following a design competition which began July 1, 1959.

Skyhawk is now the full-scale development and is expected to be operational by the middle of next year. The Skyhawk is a lightweight guided missile system for close support of ground troops.

Vehicle mounting is one application of the system which will make use of 14000 servovalve (remote techniques and mechanical high performance gyromotors) and an electronic computer for guidance and control.

Aeronutronic has selected Raytheon Manufacturing Co. as its subcontractor for development of the missile's fire control system. Raytheon's active system development will be undertaken at its Santa Barbara, Calif., laboratory.

Aurora reports it will spend approximately \$15 million on the project during the current fiscal year, and that

the development contract eventually is expected to run to about \$25 million.

The Skyhawk program will be controlled as a \$10,000 in its plant in Menlo Park, Calif., directed by Roy P. Jack, vice president of Aeronutronic's Western Division.

Chrysler Truck Automotive Company, Detroit, Mich., is responsible for development of the Skyhawk airframe. The Aero Model and Control Systems Agency at Rockville, General Electric, in contract engineering, working under the Chrysler Truck Automotive Company.

News Digest

Aeronutronic Air Force is negotiating with State Department and Air Force to obtain financing for purchase of 18 North American F-85 fighters. Defense Department has \$100 million set aside for credit extension to foreign governments for military equipment purchases.

Grumman Co. of Aeromarine has received a \$50,000 Navy contract for construction and testing of a monomorph, 15-ft diameter ground effect vehicle (AW Jan 12, p. 34).

Bids for the Phase III static test facility of a sub launch test complex at Palmdale AFB, Calif., are being submitted to U. S. Army Engineer District, Los Angeles, for opening on May 7. While not specifically awarded, the complex is associated with the development program for the Minuteman solid propellant ICBM.

Raytheon Aircraft Co. has been awarded last week to split the program's stock 24 to 1 and to pay an annual dividend rate of 20 cents a share on the new stock, to effect a 25% dividend increase (AW Nov 15, p. 27). The split will increase the total number of Raytheon shares from 540,568 to 1,351,420.

North American Aviation, Inc.'s Cedarhurst, Ohio, division has received a \$19.3 million Navy contract for production of 10 F-100 jet fighters. Six of the fighters already have been delivered to the Navy and are undergoing test evaluation at the Naval Air Test Center, Patuxent River, Md.

Verbal Aircraft Corp. reports an 11% increase in earnings during the first quarter of 1959 over the same period of 1958 despite a 20% decline in sales. Net earnings for the quarter totaled \$179,890 on sales of \$3,915,465 as compared with \$162,635 on sales of \$10,183,289 for 1958.



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LEADING INNOVATOR AND PRODUCER OF ADVANCED ELECTROHYDRAULIC SERVOVALVES

F-27 Sales

Fairchild Engine & Airplane Co. is negotiating sales of 21 F-27 turboprop transports—15 to Aeromarine Argentina, three to Colombia and five to Turkey's national airline.

Stockholders were told that the company also is in the talking stage with USAF and with several foreign customers. There are 85 new orders for the airplane, that is sales with a five-month lead and deposit and not including options. Twenty-one had been delivered as of last week.

Northwest Wins Round in BOAC Battle

CAB examiner proposes denial of British carrier's bid for Tokyo stop on its around-the-world route.

By I. L. Day

Washington—Northwest Airlines last week won the first round in its bid to prevent British Overseas Airways Corp. from serving Tokyo as a round-the-world route when a Civil Aeronautics Board examiner recommended Board support of the U.S. carrier's position.

In a surprise move, CAB Examiner Ferdinand D. Moon concluded that BOAC's request for a Tokyo stop should be denied but that a foreign air carrier permit should be granted to the British company authorizing an around-the-world route via Hong Kong, Wake, Honolulu, San Francisco and New York. Briefs and exceptions are scheduled to be filed today. Since Northwest is expected to request oral arguments in the case, a final Board decision may be delayed by as long as another two weeks.

The British government, meanwhile, made a final attempt to bargain with Northwest, with intervention in the case when it proposed opening of negotiations at government level on an extension of Northwest's route from Tokyo into Hong Kong. Northwest turned down the offer as it did earlier when the British offered to negotiate for the route at airline level (AW/ April 30, p. 42).

Moon's recommended decision hinged on his finding that public interest in worldwide routes must be met by an isolated service that would be developed as U.S. interests. His decision partially nullified Northwest's position, which urged only the denial of the Tokyo stop but agreed to the around-the-world service via Hong Kong and Honolulu.

State Department Stands

Previously, State Department had indicated its support of the BOAC position through its interpretation of Section IV (4) of the Bermuda pact. The Board's decision caused it to fear that the potential effect to encourage other U.S. carriers is outweighed by other public interest considerations found in the existing bilateral agreement.

Moon, however, held that "the position of a BOAC U.S. Tokyo route holds grave dimensions directly not only to the Pacific carrier whose services have required heavy government subsidy but also to the domestic air lines which depend upon interline traffic from the U.S. Tokyo markets to feed substantial support to their domestic services."

He concluded that, since Northwest and Pan American had developed the Pacific market with approximately 500 million of federal subsidy support, the public interest does not permit the huge

aided, in part a minor step but a significant traffic generating air on global routes.

In this connection, a spokesman for the British embassy told *Airways Week* that the present case represents the only time the United Kingdom has requested a stop not listed in the Bermuda Agreement.

He added that between 1946 and 1955, the U.S. has made requests and has received approval for 12 stops not included in the pact.

Moon said in his initial decision that "Tokyo, equal in size to New York, occupies a unique position of vital importance in the United States-Oceania traffic flow on the American flag carriers."

"As a general traffic generating center, it accounts for over 80% of all transpacific traffic, including that of foreign flag carriers."

Advantage to BOAC

According to Northwest, BOAC could earn any intercontinental profits at a level once it had a permit authorizing a Tokyo stop.

The carrier said it could operate non-stop between Tokyo and San Francisco as between Tokyo and New York.

Moon concluded that "an industry improves as it is able to reach operations feasible, BOAC can thus operate routes which have a complete competitive advantage of United States routes."

Moon emphasized the effects of the discriminatory impact on U.S. carriers that could be caused by authorizing a BOAC stop at Tokyo. He spoke of BOAC as a "global airline with access to all the principal air markets of the world" and noted that BOAC's routes and services already total 112,441 on every continent.

He added that the BOAC route systems would be backed by the substantial resources of Cathay Pacific and Hong Kong Airways to enable the British carrier to earn many significant profits in the Far East. He also noted that BOAC would be based at Honolulu by the Queen's route from Australia that "enjoying the benefits of a strong British partnership route system operating profits on a \$600 per U.S. route between Honolulu and New York."

Northwest's estimate of damage to BOAC from transpacific services is based on 1957 traffic statistics and is calculated as high as 59,550,000 per cent. Considering a normal growth of 18% per year from 1957, diversion of

the 1960 level is set at \$12.7 million per year.

How is what Moon had to say as the subject of bailout operations?

"The threat of heavy diversion by BOAC is particularly important to Northwest Airlines in its present state of transition from passenger and cargo service to Tokyo service in the DC-8 as an aircraft in new air service route. In 1955, Northwest averaged only 33 passengers per flight on its U.S. Tokyo service. Early in 1960, the 120

seat jet aircraft will be placed in this service, and the company must rely heavily, not only on diversion of its existing traffic, but upon the continued growth of its Tokyo traffic to sustain an even perhaps excessive transition to jet operation."

Northwest has expressed confidence that it could make the transition to jet operations successfully if so for the traffic diversionary factors were introduced. As a result, Moon concluded that it would be unreasonable to "use this very

traffic required by the U.S. carrier to meet the jet air challenge directed at it by BOAC in foreign air carrier operating in a third country role."

Moon also wanted that present operation—Japan Air Lines and Canadian Pacific—will introduce "selective" transpacific routes and added:

"The U.S. carrier must assert its growing competition with the frequency and quality of service which still maintains the position of the U.S. in the Pacific area."



PART of a record 21 ton freight load is about to be loaded into a Flying Tiger Lockheed Super H Constellation 400 fighter.

Flying Tiger Predicts Boost in Revenues

Washington—Flying Tiger Line, bolstered by a 48% gain in revenues during the first quarter of the year, now expects its reports of gross revenues to reach \$40 million for its 1959 fiscal year which ends June 30.

Last year, the company's revenues topped \$35 million for a modest profit of \$1.25 per share of common stock. However, 68% of the profits represented capital gains from the sale of DC-6A and C-46 aircraft.

This year, per share earnings are expected to reach \$2.25, with 80% of the profits coming directly from operations.

The progress, reflected by a high of \$10 on the company's stock listed on the American Stock Exchange com-

pared to a 1958 range of \$5.52, is attributed by company President Robert W. Prescott to the introduction of Shik, Aerovis from service (AW June 16, p. 79) and improved efficiency brought about by the introduction of Lockheed Constellation 100s.

Expansion Plans

Next week, the carrier plans to increase its fleet to include six new aircraft as a move to combat the growing threat of increased competition from scheduled airlines now converting passenger aircraft into all-freight passenger-carrying Flying Tiger aircraft. It will acquire three new Boeing 707-300s through its freight sales program and its full jet cargo handling

At the same time, the carrier is prepared to spend some \$50 million for a fleet of 10 turboprop aircraft over an acceptable turboprop cargo plane because available.

Chief interest is now centered on a proposed cargo version of the Douglas DC-8 which can be operated at a direct operating cost of 15 cents per ton mile in comparison with the 74 cents for the Constellation.

At present, Flying Tiger is making a 12.5% contribution on its fleet of 14 Lockheed 104Ws and, on December, is reported a lost factor of 84%. Loading and unloading times at terminal points have been reduced to an average of two hours, as efficiency shrinks the carrier will expect of a turboprop fleet despite

ways in flight time over price-performance.

An estimated 60% of the company's revenues is derived from the Military Air Transport Service (MATRIS) charter, but revenues from freight are increasing substantially—up about 15% for the last half of the calendar year. At 10 percent, the airline is handling about 12% of all domestic air freight.

Large factor in the development of air freight by Thai Tiger has been the successful application of an aircraft system. Direct air connections with trucking facilities serving 33 points from major terminals covered by Flying Tiger under a combined air-truck shipping rate is expected to increase markedly (estimated by \$18,000 to \$20,000).

Sales techniques now include joint airline-trucker analysis of distribution costs as a means of pointing out advantages of air freight. Recent example of success is the export of rice. The program developed for American Oil Co. which last year used an estimated \$250,000 through the use of air freight.

American Oil's distribution and

transportation experts furnished figures on costs of rail, truck and air freight to each customer. Their findings with studies of basic point-to-point methods of cargo handling proved by Thai Tiger scheme.

The shipping program which now dominates Thai Tiger is a savings of about 40% in necessary costs to the customer alone and a reduction in manpower of 25%.

However, Prescott feels that public education is the key to air freight in far less complex. Chief goal now is to concentrate on long-haul routes feeding freight in and out of major terminals to cut direct operating costs and to reduce tariffs so that air freight will be in position to "be the highest profit item in the line."

During the first six months of the current fiscal year, direct flight expenses are shared by 10% and indirect costs per mile are expected to decline as a result of traffic increases. Flying Tiger feels that efficiency is the key to lower freight rates and hence reliance on the part of shippers to widespread use of air freight for long-haul distribution purposes.

Pan American Pilots Finance Plan To Bolster U.S. Bilateral Stand

Washington—Group of Pan American pilots, in an unprecedented action, have voluntarily launched a self-financing campaign to help the Civil Aeronautics Board, but a being billed as "a report to the citizens of the U.S." it is established and as being pushed independently of any interests or policies adopted in this field by Pan American management.

Main purpose of the campaign is to tell officials and public attention to the continuing decline in job opportunities for U.S. airline personnel as the result of annual income being made by foreign flag carriers on international flights leaving to and from U.S. ports of entry. The comprehensive survey project is the pilots to back their own cause and to present a comprehensive survey of the current status of U.S. flag carriers as the international field.

Activities of the non-profit limited by Capt. A. I. Propp, has the backing of the Pan American pilot group as a whole. In his address to the dedicated survey and report, Propp emphasizes that the findings "represent the position of only our pilot group and

are intended to convey information that has been reached as a result of our years of experience and observations on events in international aviation."

The pilots assert that they desire reflect events that apply specifically to Pan American. They have prepared five reports on the basis that Pan American routes are open to the world, without restriction, and therefore their conclusion are generally applicable to the U.S. position in international aviation.

The group stresses that the study does not of the percentage of traffic carried by U.S. airlines has created "job advancement and expanded job opportunities for the foreign citizens as the

expense of national jobs opportunity as well as employment, distribution and loss in corresponding position."

Here are the specific examples of assumed employment growth cited by the pilots:

•No World War II or Korean War service among Thai American as a result of flying mission of hostilities has reached the status of captain.

•Present pilot roster of Pan American contains captain with the most experience and with more than two million total flight experience. Seven pilots of American, Eastern, United and TWA have approximately six years or, previous before advancing to the position of captain, according to the report.

•Pilot complement in Alaskan operations has shrunk 30% since 1950 to that only one service are now used in this area.

•The pilot roster had more captain on the pilot roster last in 1945 than in the spring of 1958 although senior pilots in the U.S. have increased their number in number since 1945.

•Presented statistics at the Division Headquarters of the Latin American Division were reduced by 5% as a result of leave cooperation in the South American pilot (AWM May 25, p. 48).

The report charges that "our own people in public affairs appear to be depending on statistics 'Pan American route' in presenting the development of the company's route pattern. However, the report noted that it now has a Civil Aeronautics Board that is "directly responsible of leadership, financial means and direction."

Quotas End

A spokesman for the pilot group cited in an interview the recent CAB decision on the Quotas to end quota between U.S. ports (AWM April 13, p. 38) and the carrier's mutual decision in the British Overseas Airways Commission (see p. 28) as examples of what he would like to see done to ease in the handling of international route affairs.

The pilots do not confuse their attack in foreign flag carrier but emphasize the effect on employment of U.S. carriers in the Latin American market has had on Pan American during the past 13 years. In terms of passenger income sales, the pilots say Pan American lost \$10 million in Latin America during 1957 over 1956 and in 1958 lost \$20 million in Latin America during 1958 over 1957.

The pilots list head at the Board's refusal to send the entire domestic market and pointed to the fact that eight U.S. airlines have "lost" over \$100 million in domestic income to their international operations.

In the North Atlantic area, the pilots

said that 74% of the traffic on this route was handled by U.S. airlines in 1948. They conclude that "both carrier and customer of the proposed U.S. restriction on this route have actually observed the decline of their total income to a point where 1957 flight carried by TWA and Pan American was less than 1948."

They also stated that Pan American and TWA now fall into the 90% increase of traffic into the North Atlantic area of the present trend continues, despite the prediction that 70% of all the traffic will be U.S. carriers.

In the final summary of the report, the pilots note that the number of carrier operating on international routes appear to make considerable evidence the most direct, the most efficient and the most logical of any existing "regulated business" and add that "still further foreign carriers are claiming for cuts into the U.S. market."

The group expects that 23 foreign countries have traffic rights to more than one point in the U.S. or rights beyond the U.S. and concludes:

"As a U.S. carrier, we feel as undisturbed as we have been in the past of our own country, and we feel as undisturbed as we have been in the past of our own country."

Here, we note of the recommendations made by the Pan American carrier:

•Study of past and present procedures followed in bilateral negotiations and administration of these agreements to secure compliance by the other party.

•Study of the international route structure to determine whether it is profitable to maintain the current structure of the government in diplomatic and defense considerations when acting upon international route matters to U.S. carrier.

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JAL Urges Intercity Helicopter Service

Tokyo—Japan Air Lines has asked the Ministry of Transportation for support and assistance in the airline's experimental use of long helicopters in preparation for regular commercial helicopter service within Japan.

Research given for the report noted:

•The helicopter becomes a drawback to fast or service over long distances, such as Japan to Hawaii, while other means of transportation are increasing in speed—the introduction of high-speed railroads between Tokyo and Osaka, for example.

•Development of such helicopter in the future, Japan Airlines' American Verbal 100 and Sikorski 550 has reached the point where they can be practically employed in commercial operations in Japan.

•With maximum speed of approximately 160 to 180 mph, these aircraft are almost comparable to jet transports for short-haul operations of 200 to 300 mi., considering the time used by operations between the hours of cities.

A Japan Air Lines spokesman said it is up to the Transportation Ministry to give approval to put helicopters into service in domestic routes.

BEA Viscount Makes Trial Moscow Flight

Moscow—A British European Airways Viscount landed at Moscow Airport last week at the end of the first regular flight from London to Moscow for twice-weekly regular jet service scheduled to begin May 14.

The flight carried Lord Balfour of Liverpool, company director, as well as technical personnel and three pilots.

British European Airways began to establish an office here. It succeeded BEA will have the only British business office in Moscow.

BEA officials scheduled to start under Moscow-London service will fly to the same week that BEA flights will begin.

Fer Noise Complaints Force Flight Changes

New York—Pan American World Airways has been forced by London Airport authorities to schedule New York-London jet service at planned to add on April 27 because of complaints from the community of Longford near airport, the plane will not leave London at 1:30 a.m. as planned, but instead will depart at 1:00 p.m. in London time. The problem concerned jet noise.

Rescheduling of the additional London flight has necessitated another schedule change for PanAm in its jet service. A flight to be added June 1 between New York and Paris has been scheduled at 4:45 p.m. in all of Midwest time, and the flight will not leave London at 9 a.m. in all shift depart.

The new London flight will depart New York at 9:30 p.m. in instead of 10 a.m.

PanAm 707 Damaged In Landing Accident

New York—A Pan American World Airways Boeing 707-40 jet transport was scheduled to go back into service last night after repair following a landing accident at Grissom Field on Long Island.

The 707-130 landed short on a runway light and snapped its right landing gear strut.

Scott Flanagan, PanAm's assistant chief pilot-technical was at the controls when the jet landed just short of Runway 23 in a strip of meadow. Six crewmen were aboard the plane, which bounced, and about three-fourths of the length of the runway, and came to rest just off the runway and slightly damaged to the right.

A helicopter for brake out and was quickly dispatched by Grissom's fire fighters.

The plane was brought back to New York International Airport last night on three engines. The paid of No. 3 engine broke the wing of the jet's right side as it skidded along the run after the jet's gear struck, and the gear separated from the airplane.

No one was injured in the incident. The flight was a routine training operation for the purpose of practicing landing.

No emergency had been declared and the landing, for all intents and purposes, seemed normal until the impact occurred.

TWA Jet Expansion Includes Baltimore

New York—Further expansion of "Twin World Airline" jet services was scheduled to begin last week with introduction of daily Boeing 707-138 flights between New York and Los Angeles.

Another round trip schedule between the two cities is planned to begin May 1.

Within the next few weeks, TWA plans to add Baltimore's Friendship Airport to its jet trips and to provide jet service between Los Angeles and San Francisco.

The airline also expects to add a second New York-San Francisco schedule in June.

No specific date has been set for the Baltimore-San Francisco flights, which will stop at Los Angeles. The current between jet service May 20 between New York and San Francisco and added Los Angeles flights on April 9.

The expansion program will increase through the summer, TWA said, as delivery of additional aircraft on order.

American Sets Transport Disposal Pace

By Glenn Garrison

New York—Plans for disposition of American Airlines' private fleet indicate the correct sales mix of aircraft and how they are likely to play in the next aircraft market as more airlines close airplanes in line with their jet equipment programs.

American will not sit back with its private disposal plans, it is planning these planes out gradually over a period scheduled to end in 1984. It has already ordered and set arranged for the sale of 114 private aircraft, and another 10 Douglas DC-7s are accounted for by plans to convert them to freighters (AW Feb 9, p. 47). Another 36 of American's private planes are under option for sale.

Boeing's contract for American's jet equipment is backlogs. But American Airlines' aircraft backlog, from which it has agreed to buy 75 of the airline's private planes and has taken first refusal on 30 more (AW Aug 6, p. 41). Other transactions have been made of 25 DC-7s to General Aviation and Leasing, Division of General Dynamics Corp. Ten of these planes have been delivered and the rest are scheduled to be delivered in the next few months.

One of 10 General 240s was converted to a turboprop by Dornier, Inc., but American subsequently bought that firm and took over the disposal of all of the General 240s. The other 16 had been sold by Dornier to a Latin American buyer.

The remaining four American aircraft already disposed of were DC-6s now landed by the airline as direct sales to several airlines and buyers.

American has contracted to buy 50 of American's General 240s, 45 of its DC-6 series airplanes and has obtained first refusal rights on American's remaining 36 DC-6 series planes. The New York bureau also has placed orders with last September for two DC-6s and three General 240s from Continental Air Lines.

Tuning Factors

Airline operations and scheduling is closely oriented to the nation of sale, not only buying. First American considers the General and Douglas DC-6 airplanes top resale assets in today's market compared with other aircraft being readily available, such as the Boeing Stearman. Second, American is carefully timing its receipt of aircraft for fast movement through lease or sale, and a consequent maximum retention of sale assets.

Over 12 airplanes, all General, have actually been placed out of airline operation and delivered to American for five of them, aircraft have been resold, three to corporations and two to South East Airlines, which also has ordered two additional 240s. Two of the 12 General are out on long-term lease, and there are going to be more airline on lease in the near future. Two planes in need by American in a demonstration. The

11th airplane has just been received from American at North Ward and is up for sale.

The Douglas DC-6 planes have been tracked to here and have appeared with no more than a one-day lag, but will be turned over gradually and, to some extent, at American's convenience.

Approximate delivery schedule from American calls for another General in the month and the next of about two a month with final deliveries in the fall of 1979. The DC-6s will start going to American at the rate of two a month, possibly not later than September, but the airline's planning doesn't yet extend past the end of the year according to American. Only about eight DC-6s are accounted for in its own or a fairly definite schedule.

The airline expects to get its DC-6s from Continental in July and September, and two Continental General 240s within the next month. The final General 240 has been delivered to New York's General Aviation Regulatory Co. American's current disposal of its own assets tends to a balance of the cash value of its purchases if it can keep ahead of deliveries on its sale and lease transactions. This makes having aircraft important.

The company expects some help along these lines from American, if needed. For example, if American had an excellent prospect for a DC-6, the airline might attempt to place out the aircraft ahead of schedule, or the airline could in tight deals release all its aircraft to give American a little extra time to keep a customer the broker and

Feasible Changes

American's contract with American concerning purchase of the aircraft, however, is a firm agreement with possible changes. President B. A. Auer, president and owner of the brokerage firm, told Aviation Week.

Regarding his own jet operation, Auer said he plans to offer a variety of packages to prospective buyers in light of his recent fleet aircraft. These include sales, long and short-term leases, lease agreements, consulting, insurance, financing, training, technical aid programs in flight training and maintenance. Auer will offer these deals in varying combinations depending on airline needs.

The short-term lease program would seem to require particularly precise take and market evaluation. For example, Auer might have arranged to buy a DC-6 to go and on lease to one airline for its peak workload season, then to another airline whose peak was in the summer.

Auer would never physically take de-



Pan American Constructs New York Terminal

Steel and supports have been installed for Pan American World Airways' new \$8 million passenger terminal at New York International Airport. Jet passengers will now make the airline's existing plane loading and unloading procedures. Steel support is made up of 32 steel girders, forming internal and external frame.

Every of the airplane, it would arrive at American's maintenance base for painting and the like a month or so before going into service. After it had passed that airline's peak demands, it would go to American's shops and then onto that carrier's schedule. Terms of the lease would be arranged, if necessary, to cover a month or so to each airline while the plane was made in less in storage rather than on the line.

Short Term Lease

For American, the short-term lease rate would probably have to allow for any lease left in the market value of the plane over the period of several years if it was not working for the leasing company.

While questions of cost have not been asked, Auer said he plans to offer the services of an American specialist staff team to analyze an airline's needs and a financial structure and determine just what a reasonable equipment program would be for that carrier. Such a study might affect the number of planes bought, if any, or whether lease arrangements might be more appropriate.

As an example, of the technical and Auer will offer the purchase of two General 240s, Southwest Airlines, just purchased to American's T-125 aircraft, more lease for maintenance, and its pilots, nearest flight instructions with American's American as far as the service.

While airlines are involved, de-

ivery and training again will be the big factors. An airline with DC-6s to buy as part of a DC-6 purchase deal, for example, might do better and more with its old equipment because DC-6s are still considered a reasonably good choice, but, in a hasty evaluation, the DC-6 was due for a big plunge in price, the customer might do better to consider spending a share of DC-6s down with its old equipment.

But a sale of aircraft with continuing confusion (including the DC-6, in American's estimate) may be an element in American's sale. It would allow aircraft to be sold at a price, the better would provide airlines with a constant tool to upgrade their equipment, using the reduced value of equipment in trade resale and that making that equipment available to an airline lease on the equipment sale to upgrade its fleet. This point would also include planes for lease and Auer itself would analyze physically take possession of any plane.

American's whole approach would seem to call for considerably less in upgrading various elements of lease, market value, trade needs and the like, but if all the tools were kept successfully in the air it would be more difficult to sell.

As a result of the technical and Auer will offer the purchase of two General 240s, Southwest Airlines, just purchased to American's T-125 aircraft, more lease for maintenance, and its pilots, nearest flight instructions with American's American as far as the service.

and 750 Design, Inc., in New York. There are also potential corporate customers for a lot of the DC-6s.

Latin America, Auer said, it is the best foreign potential used aircraft market.

Auer has set asking sales prices for the DC-6 series from \$575,000 for a 50 passenger DC-6 to \$1,575,000 for a DC-6A cargo plane. In between are the 60 passenger DC-6 at \$653,000, the 62 passenger 1970 DC-6B at \$700,000, and the 62 passenger 1973 DC-6B at \$775,000. The General price range from \$198,000 for a 40 passenger to \$400,000 for a 70 passenger. The 70 passenger 1970 DC-6B at \$653,000 for a 70 passenger 1973 DC-6B at \$775,000.

American's aircraft are listed on the Aero Exchange (AW Dec 8, p. 25), at a 10% markup over its own asking prices. American's prices for private aircraft are set by American's own prices, because of its excellent rental plane relations in establishing the offering.

General Aircraft's Plan

General Aircraft and Leasing has taken delivery of about 10 of the American DC-6s, which are stored at Cheyenne, Wyoming with Land Air, Inc., a subsidiary of California Eastern Airlines. All of the aircraft are to be delivered in July.

None of the DC-6s has been sold by General Aircraft according to C. M. Britt, vice president sales. The sale to General Aircraft was part of an agreement with American Airlines, which is a subsidiary of General Dynamics Corp. (AW Aug 4, 1978, p. 18).

General's approach would therefore seem to differ in some respects from American's. General's program has not been specified out as yet in detail, and will emphasize "flexibility," Britt explained.

The DC-7, in Britt's view, will be valuable in an intermediate range, four at a time aircraft for use as air carriers with private operating on long range main where they are most efficient. Other possibilities for the DC-7 are in intermediate range for commuter use in short range and in freighters. General will offer them to customers in terms of their freightage as either already converted or in.

General also has a variety of leasing opportunities in the airline market, "an entire new phase of financing in air transport." Leasing may be taken over for the requirements of each customer, and the whole used aircraft disposal problem calls for the general flexibility in lease as well as in sales arrangements.

General has not entered into any purchase transaction other than the one with American as yet, according to Britt. But the American deal, he said, was widely to be General's last transaction.



Sound Suppressors, Reversers Installed on 880

They replace type sound suppressors and thrust reversers have been installed on the General 880 jet transport's General 880's CRJ-100 transport engine. The engine is a modified design, giving about 10,000 thrust through a modified thrust reverser of the engine pod (AW Nov 17, p. 31). The thrust reverser is a new No. 3 General 880. They provide design measures that are to reduce thrust with ambient air.



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The Canadair-Conquest '540', by the application of turbine power, becomes the ultimate development of the widely used and approved Conquest 340-340-440 series. The '540' is now on order and in full scale production, and is currently being demonstrated to airlines and business aircraft owners throughout North America.

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SHORTLINES

► **British Overseas Airways Corp.** claims first place among foreign flag carriers in total number of passengers carried over transatlantic routes during the first quarter, 1977. BOAC, in raising passenger fares for the quarter, said passenger loads have increased 54% over the same quarter of 1976. The British carrier now plans to increase its next quarter 51% over last summer on its week schedules.

► **Continental Air Lines**, scheduled to begin Boeing 747-120 service between Chicago and Los Angeles with a single jet transport on June 6, plans to increase the service to three round trips daily on June 22. One new service to be offered on Continental's jet aircraft will be inter-city or first class passenger service. A Continental official says reception on jets is good at the 15,000 it anticipates the airline will fly.

► **Eastern Air Lines** was scheduled to begin this week a new-type aircraft service over 12 points on its routes offering complimentary hot meals and in-flight beverage service at a \$1.00 charge on 89 recently delivered Douglas DC-7B aircraft. Five airlines on the coach flights will be \$2.50 and subject to approval by the Civil Aeronautics Board.

► **Great American Media** is increasing its transatlantic schedule from one to three weekly flights on Min 1 using Douglas DC-6 aircraft. Coast and Southern Airlines Britain recently concluded an agreement whereby \$48 sets as technical advice to Great and its parent, Media, invest and business structures.

► **Irish Air Lines of Spain** will accelerate its transatlantic schedule to five weekly services flights from New York to Madrid on May 1.

► **Mohawk Airlines** expects to file a net profit of \$275,000 for the year ending last Dec. 31 despite operating revenues of \$8,492,000 and operating expenses of \$8,825,000. The airline ran the previous year of more than \$1 million in total net period loss per month offset the higher expense figure.

► **Pacific Western Airlines** showed a net profit of \$180,581 for the year ending last Dec. 31, the highest in the company's history.

► **Texas-Canada Air Lines** will offer a 15% increase in transatlantic trans-Atlantic routes on its weekly schedules effective this week.

AIRLINE OBSERVER

► **New York financial sources** and **American Airlines'** latest financing (AW April 20, p. 40) was not a matter of necessity but of opportunity. Americans already had received its basic jet requirements, but believe, adding that the new financing might give the company a ready source of funds in the event a separate transport appears through or cash to handle a merger at the opportunity for acquisition should arise. In other words, Wall Street feels that American, with such a hand, will be in a strong position to take quick advantage of any expensive opportunities which may appear.

► **Civil Aeronautics Board** Examiner Ferdinand D. Munn's recommendation in the British Overseas Airways Corp. application for a Tokyo stop came at a complete surprise. With only Northwest Airlines intervening and with strong State Department pressure favoring the British proposal, most observers felt that an initial decision supporting the British application was virtually a foregone conclusion. Fearing now is that the Board will back Munn but that the White House may well reverse the decision. No matter what the final outcome is, the case will definitely carry long-range significance as all future U. S. bilateral air transport pacts.

► **Airline traffic** continued to remain heavy during the first two weeks of April following the slack upward trend set during the first quarter of the year (AW April 20, p. 39).

► **Russia** is preparing to place its two-engine Yak 24 helicopter in commercial passenger service. A 30-seat cabin arrangement has been approved. First exhibited at the 1975 Yafanov air show, the Yak 24 has been thoroughly tested by Russia's aviation services.

► **Pont & Wintour** recently filed the average utilization of the company's 177 jet engines in airline service to date has been approximately eight hours per day in comparison with a utilization of around seven hours per day for the P&W JT3D engine during a similar time span when the latter engine being introduced into service on the Douglas DC-6.

► **Vickers Armstrongs** will accelerate a cruise speed of 425 mph for its turboprop Vanguard now powered by Rolls-Royce Trent II engines. Vanguard may make its first appearance overseas at Hamburg on May 6 and is scheduled to be shown at the Paris air show on June 12-21.

► **Seawind** spokesman at Gray's Court airport are waiting another order and Taurus at the Douglas DC-1 assigned to Federal Aviation Agency's flight inspection group operating out of Beirut. Mission is largely restricted to the collection of VOR facilities in the Middle East and Africa. FAA specialists have recently finished a tour at the area, checking VOR systems at Cairo, Nairobi, Khartoum, Aden and Salisbury, as well as East Africa.

► **Texas World Airlines** filed the Civil Aeronautics Board last week jet schedules already submitted by TWA and United in the New York-San Francisco market will produce \$15,000 seats by 1980 in comparison with the current \$15,000 seats per potential flying passengers that are expected to be the service that year. Airlines which are making a bid for morning flights between the two points, charged that development of the route had lagged behind that of Los Angeles-New York due to inadequate in service.

► **Schulard & Western Airlines** last week increased its daily transatlantic arrival and departure service to two flights daily. Civil Aeronautics Board earlier this month authorized the airline to carry mail on its all-cargo Atlanta routes on a service to base.

► **Recently** concluded Third Congress of the Communist Polish United Workers Party approved directives calling for expansion and improvement of LOT's fleet, service, operations under the nation's new seven year plan. During the 1959-1965 period, Poland hopes to "extend domestic and foreign air routes, add jet and turboprop planes to the civil aviation fleet, rebuild airports in accordance with the latest requirements and provide their fields with complete facilities and equipment."



BRITANNIA

demonstrated by new

Britannia 212's play leading part in first-ever round-the-world jet airliner service

Latest evidence of Britannia dependability and operating economy is provided by BOAC's enterprise in setting up the first-ever round-the-world jet airliner service.* This achievement by a British airline using British aircraft makes it possible to fly round the world in 3 days, 14 hours, 50 minutes—less than 87 hours, a figure expected to be reduced soon to under 80 hours.

Britannia versatility brings profit to operators

Already Britannia routes circle the earth, service around every major city in the world. Britannias fly over 25 million miles a month, show unique range flexibility by covering stage lengths ranging from 360 miles inter-city to nearly 5,000 miles transoceanic. They make no special demands on length and strength of existing runways.

At the same time Britannias are attracting passenger traffic with their quiet comfort and cruising speeds of over 400 mph—at least as high as any turbo-prop or jet-engine aircraft in service anywhere in the world today. They prove their versatility by carrying a tremendous variety of freight loads, and being profit to operators.

New traffic

Since introducing Britannias, El Al Israel Airlines have added their share of transatlantic traffic, while Canadian

Pacific Airlines on their transpac Vancouver-Amsterdam route in 1956 gained a 32% increase in seatload traffic over the same period of the preceding year.

Big Charter assignments

Air Charter Ltd., Britannia flights between Christmas Island and Great Britain have been carrying on less than 128 persons—largest ever passenger loads regularly carried on any of the Atlantic by a civil operator. Only 12 days after receiving their first Britannias, Air Charter had completed a full winter-passing program across the Atlantic and Pacific, the aircraft was then entering winter season service. Furthermore, in its first three months, it achieved an average utilization of 7.28 hours a day.

Shocking-Cla Air Transport experiences, too, has put one of the Britannias scheduled at carrying large payloads at high speed over long distances. Recently a Hastings-Isle Britannia flew round the world in 64 hours flying time—a distance of 24,000 miles at an average speed of 374 mph. On the Christmas Island London leg of the flight the aircraft was carrying 167 persons.

Engine reliability

Britannia operating economy is noted particularly in the proven reliability of its Proteus engines. Overhaul life on the Proteus 700 series reached 2,000 hours in under 3 years. No engine of comparable power in service today



BOAC routes circle the earth, service around every major city in the world

BOAC, CAL. S.A., BOEING, COWAY, EL AL, SPA, AIRFRANCE, GAA, GURAMA

reliability, profitability BOAC enterprise

lose its overhead life that even approaches the length. Actual engine overhaul costs for BOAC's Britannia 107's have been cut by 70% since the aircraft went into service. Continued development will give Proteus even longer overhaul life, reducing even lower operating costs.



Meanwhile, current versions of the engines give greater power, lower fuel consumption, and materially improve the Britannia's cruising speed, range, and take-off performance.

Finally—Britannia overall profitability is evidenced by airline experience. El Al's Britannias are operating at a break-even cost approximately 20% less than any previously experienced.

Other recent Britannia airline achievements

BOAC entered Britannia services—in Toronto's via Toronto, Mexico, across USA to San Francisco, and via Montreal to Detroit and Chicago.

Glenn Airmail—a BOAC subsidiary—introduce Britannias on weekly London-Buenos Aires service on April 15.

Aeromexico de Mexico Britannia services have been doing more than an hour off previous Mexico City-New York schedule. Now all Aeromexico de Mexico Britannias have been New York-New York in a less than 24 hours (4:41 night), beating own record (off 4 hrs 2 mins) made only the previous week. Load factors have been extremely high.

Canada de Montreal by return journey after an expanded flight. Montreal-Vancouver City on record-breaking 7 hrs 12 mins—clearly to set up Britannia services between New York, and transatlantic via London to Montreal.

*El Al on 1956-1957 season

BRISTOL
Britannia

BRISTOL AERONAUTICAL CO. (U.S.A.) INC.
600 PARK AVENUE, NEW YORK 22, N.Y.



ADCOSE of Skanska's S-81 truck refuse roll baler was rolled out west to debut in the Fall at show

Detailed Mockup Displays S-61 Layout

Stationed, Coast—For details of St. Louis, Australia's 5th team on tropical islands, commercial helicopter call for a 1,000 lb. payload in the 29-passenger version and a target overhead payload of 1,800 lb. by 1992 for all major components.

A rendering of the shop, with color scheme and exterior by Raymond Lewis Associates, has been completed and is being prepared for shipment. Test work for display at the French International Art Show, at Paris is in progress.

Two basic all-passenger arrangements are specified: a longer range version including galleys and lavatories accommodates 22 passengers and a shorter range version carries 23.

Various passenger-cargo configurations also are offered. The first three seat rows can be folded to the side to provide 411 cu ft of cargo space and 15 passenger. A light mesh stowable partition separates passenger and cargo compartments. This partition can be placed at any of the first three seats to provide variations between 15 and 24 passengers. With the full 27 passengers, the cargo capacity is 100 cu ft.

Performance figures given for a typical gear weight of 15-45 lb. include mpg 3.000 to 3.050; 10.17 to 10.20 lb. of fuel and 55 lb. of oil call for a range of 180 to 200 mi. and an average cruising speed of 120 kt. *Skunks* officially can

At this weight, hovering riding out of ground effect on a standard dia. is 10,500 ft. on a 100 day dia. the hovering riding in ground effect is 1,900 ft. Vertical climb is 750 fpm and best rate of climb is 1,770 fpm with respect to maximum efficiency power of 500 hp.

The triple turbine layout means that with one engine out the S-61 can maintain flight and hover. With two engines out, level flight may be maintained for up to 60 min. at 17,800 lb gross weight or the 24 min. up to 20,000 lb gross weight.

With all three engines out, an installation landing can be made with out using the 4 x 50 ft. ground roll.

Good emergency climb-out capabilities, long range, and hot day performance are the principal benefits of the three engines. A twin engine version is offered however for operators with less severe terrain, obstacle and range requirements.

Target overhaul periods for the various dynamic components will be 550 hr at the beginning of 1960, 700 hr by 1961 and 1,200 hr by 1965. The engine overhaul target is approximately the same, with a goal of 1,500 hr established for 1967. As part of the test program, Sikorsky will complete by mid-1965 1,470 hr running of a complete helicopter.

Two of the openings are protected at

INTERIOR: Inset of the 5-68 provides for parking 23 passengers in elevator shaft section without gallery or landers.

The front of the transceiver housing is the top of the package, and is mounted directly on the main frame section for simpler lighter installation. The third region is mounted at the side of the case on the left side of the main

The frog host bell is capable of tilting and loading up to the wet-suit state 2. A retractable loading gear is mounted in the spouson and the spouson struts are designed as flat replaceable telescopic sections collapse to absorb loads in hard landings. Contact velocity as high as 17 ft/s can be made without rupturing the spouson fac cells.

As an option, either a fixed leading gear saving 40 lb., or a fixed liner gear replacing the spoolman and saving 165 lb. compared with the water slinging version are available.

Additional capabilities with the use of Sikorsky's Automatic Stabilization Equipment will be an optional item. Weather radar also is announced.

Turbine engines are General Electric T48-B engines, the same as in the Navy's B58-2 anti-submarine helicopter.

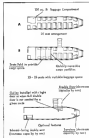
(AW Mar 31, p. 30) The S-63 is basically the same helicopter but with a 58 in. longer fuselage and the third engine T10-3 version rated at 1,850 shp. Various configuration parts will be available.

The Lowdragged mackerel *Scomber* was a light blue and ochraceous blue stripe at the window level on a white background. The hull is grey and lettering is gold.

The castling interior has a sky blue ceiling, off-white side panels, a polished carpet and a combination of these colors on the striped seats. The rear door drops down with built-in stairs, and a double door is available by utilizing one passenger seat. The front cargo door is split into upper and lower sections and opens 66 x 58 in.

The five-bladed main rotor is 62 ft. in diameter. Overall length with all blades turning is 72 ft. 6 in. Fuselage length, except for blades is 37 ft. 8 in., width 15 ft. 8 in. and height, except for blades is 15 ft. 4 in.

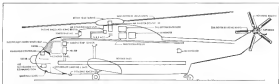
The height with blades turning is 16 ft. 8 in.



VARIOUS crop/pesticide combinations are possible in the beta S-41 column.



TRANSPORT sector has introduced efficient waste collection systems



ALL WEATHER capabilities of the S-61 are provided with the equipment, including Automatic Stabilization Equipment, provided

DAVID B. COLANTONI

52





BREAKTHROUGH in conventional techniques which permits crystals to be grown at extremely high speeds in a conventional form at this, highly polished ribbon with thin disc and flat surfaces (left), has been scored by Westinghouse Electric's Research Laboratory. At top right molecular electronic vacuum tubes developed to date by Westinghouse include solid state field effect units. At bottom is a multiple-contact semiconductor with no moving parts. A variety of other functions will be developed.

USAF Launches Moletronics Program

By Philip J. Klein

Westinghouse-Mingos new program in molecular electronics called "moletronics" for short, aimed at developing a fundamentally new approach to electronic equipment design and construction has just been launched at Westinghouse Electric Corp. by the former's Air Research & Development Command. Program objectives include the reduction of atomic equipment size and weight by factors of perhaps 1,000:1, with significant gains in reliability.

Westinghouse, which has been carrying on a long-range program in "moletronics" for several years, but already achieved significant progress on its own. For example, Westinghouse has discovered a new process for making semiconductor crystals which could revolutionize the semiconductor industry and slash the cost of making transistors by 90 to 70% (AW Feb. 16, p. 23).

The new technique, one of the program's off-shoots for the new USAF mole-

tronics program, makes it possible to grow semiconductor crystals in the convenient form of long, thin wide ribbons, a few thousandths of an inch thick, which come out perfectly flat and very highly polished, eliminating many of the costly operations formerly required to produce transistors.

Another example of Westinghouse progress to date in a solid-state, highly modulated, sensitive oscillatory circuit is the Institute of Radio Engineers convention by Col. C. H. Lewis, who has sparked the solid-state electronics seminar at ARDC headquarters.

Single Semiconductor

The complete function, which would require 14 separate components in a conventional circuit, is a photo-coupled coupling via ribbon with a constructed with conventional transistor circuit technology, is performed by a single built-upon specially formed semiconductor which occupies only 0.001 in. in cross-sectional area of the conventional size. The Westinghouse

device weighs only 0.02 gram, compared to 7 grams for a conventional circuit and has only two soldered connections, compared to 15 for a conventional circuit.

Although novel designs of this sort are expected to cause out of the Air Force/Westinghouse program, for use in most conventional atomic circuitry, they are viewed only as forerunners. The program's basic objective is far bolder and more far-reaching.

New program aims to develop an entirely new philosophy and framework for the design and fabrication of electronic equipment in which the basic building blocks will be electric fields, charges and spins, instead of the familiar resistor, capacitor, inductor, tube and transistor, according to Dr. George Siskis, acting manager and coordinator of the program for Westinghouse.

Except for the transistor and several other solid-state devices, the electronic equipment designer today still has essentially the same building blocks that

have been used for at least 50 years. Despite significant reductions in the size of conventional components, the size and weight of equipment has mushroomed because of the increasing complexity, rather than progress in electronics.

With the arrival of the space age, this problem has become even more critical. With polished perfection of the transistor, diode, tube and weight reductions of 100:1 or better are needed, with corresponding improvements in reliability.

Several years ago the Air Force recognized this, tried and began a series of leading industrial and university lab contracts in search of a possible solution. It concluded that simultaneous use of conventional components was not up to the point of diminishing return and so the concept of molecular electronics was born.

ARDC concluded that the vast, to be gained knowledge of atomic and molecular structure of materials which had come out of recent research in quantum mechanics and theory opened the door to using the basic building blocks of nature—the atom and molecule. This philosophy, and ARDC's plans to launch a molecular electronics program, was first reported by *Aviation Week* (June 2, 1958, p. 54).

Company Funds

In its search, ARDC found that Westinghouse Electric was already at work in this area using company funds. One of the earliest products of this effort was a thin semiconductor which converted high-voltage a.c. to low-voltage d.c., performing a function that formerly required a transformer, vacuum tube and filter network. One portion of the device used the carrier characteristics of a semiconductor in concert with a p-n junction, while an adjoining source of thermoelectric currents converted heat into low-voltage d.c.

Although the device was not quite as efficient as a conventional resistor it demonstrated the size, weight and cost savings which could be achieved through the use of an integrated functional approach to circuit design. This also pointed out potential economies in the engineering effort required to design electronic equipment. Instead of requiring an engineer to design the mechanical, modify the surface tube, attach the capacitor, a fourth the distance and still another to design the complete circuit, a single competent engineer might design the complete functional block in one operation.

Approximately two years ago, Westinghouse scored a breakthrough with the discovery of a new technique for growing semiconductor crystals at an extremely high rate, several of the day



CONVENTIONAL technique for growing semiconductor crystals, which may become obsolete through use of the new Westinghouse process, produces a long sheet which must be cut into thick slabs from each side must be filed to remove sharp corners and each of which must then be lapped and polished to obtain a flat, smooth-like surface.



SOLID-STATE Advanced Development Laboratory has been set up at Air Arm Division in Baltimore to advance special molecular electronic devices for specific mission requirements of Air Arm system equipment designers. Laboratory is operated by the company's Semi-conductor Division but is located in Baltimore to provide closer relationship between molecular electronic laboratory and equipment designers.

IF YOU DON'T SHOW UP HERE . . . IN

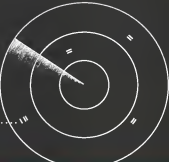
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Semantic Problems

With the launching of the new *Air Force/Westinghouse* program, semantic problems are few indeed. Some ARDC and Westinghouse officials believe the new approach is so radically different from the existing electronic state of development that a fresh start, new nomenclature is needed. The term "molecular electronics" is favored in some ARDC circles to describe the new program. An alternative seems to "molecularism."

The question of a generic term to describe such "things" as the miniature light-emitted diodes developed by Westinghouse at the tiny submicron level developed recently by Texas Instruments, goes to more controversial questions. Texas Instruments call its development "semiconductor molecularism." Westinghouse, Co. says "integrated super-circuits," but some ARDC and Westinghouse clients object strongly to any term that includes "molecularism." They say this implies use of conventional interconnected components.

To survey the concept of electronic functions being performed internally within a single blob of material, these officials prefer "molecular block" or "functional block." Other possible suggestions include "fabricate micro-circuits," "fabricate solid circuitry," or "electronic circuitry."

Existing process are in use. In addition, the semiconductor crystal comes out at the form of a thin ribbon of the desired thickness and width, with surfaces that have optical features and a carrier track. To produce a transistor in a such manner, to create problems by conventional etch or diffusion process, attach leads and slice off the transistor from the ribbon.

In use of computers, a semiconductor crystal produced by conventional techniques comes out as a large, pseudo shaped wafer which must then be cut

into them about 0.1 in. thick. Then each slice must be doped into two rectangular bars, each of which must then be lapped and polished to achieve exposed flat, polished surface below. The problems can be created and leads attached.

Westinghouse is developing about the details of its new crystal-growing process. Computer cells in "desirable growth" is a term which comes from the branching tree-like figure produced on a crystal in a foreign substance such as in iron pipe.

Westinghouse's Semiconductor Division plans to use the new, desirable crystal growth process to manufacture conventional transistors, but the new technique has many more significant potentialities which company officials will only hint at, for competitive reasons.

One is the fabrication of complex multi-function microcircuits for performing sophisticated circuit tasks in Air Force's molecular electronics program.

During the initial part of the Air Force program, Westinghouse plans to develop eight different molecular electronic circuits which perform functions of width and conventional circuits. They will include an audio amplifier, a video amplifier and a multi-channeler. In addition computer circuits will explore some of the promising possibilities of its desirable crystal growth process.

During the subsequent part, the Air Force schedule calls for Westinghouse to make a representative cross-section of various equipment across the five major spectrums according to Col. Lewis. These might include, for example, an infrared sensor, a data link receiver, a front reconnaissance receiver, a flight control system and a telemetry decoder.

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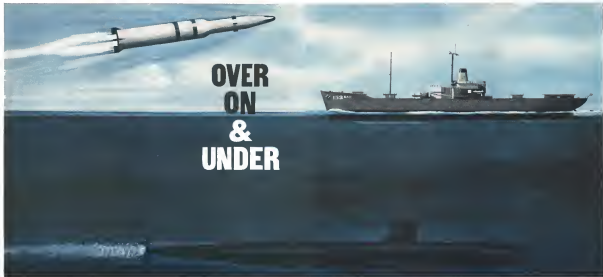
Crystal Ball

Two next year American West reports: "Semiconductor is here; in the state of the electronic art, opened by the recent discovery of quantum tunneling, quasi-volatile and high-speed circuitry."

A complete semiconductor circuit may consist of a multi-stage solid-state circuit in which various diode materials perform a variety of component functions. The entire assembly might be contained in a case no larger than last month's transistor (Wired, 5, 1967, p. 36).

In the semiconductor period has come increasing evidence to substantiate this prediction: The computer-disposition techniques of Semiconductor Inc. and Westinghouse, Co. for producing submicron-scale (AW Sept. 12, 1967, p. 73; June 2, 1967, p. 54). More recently, Texas Instruments has revealed significant progress in development of integrated submicron circuits (AW May 30, p. 52).

Now the Air Force's Air Research & Development Command has awarded a submicron dollar contract to Westinghouse Electric to break the next submicron program to date stored at this technology advance in the electronic art. Details of this new ARDC program are revealed for the first time here.



OVER ON & UNDER

A missile streaking through the sky... a ship plowing through the ocean depths... all guided with uncanny accuracy by Autonetics' inertial navigation systems.

Backer years ago development was under way on the first Autonetics' inertial navigation—a system to guide a supersonic missile to a distant target.

Since then, refined versions of this system have shown remarkable capability for guidance over, on and under the terrestrial surface in any craft, at sea speed, under any conditions—a significant advance in the state of the art.

It was an Autonetics' autonomous that guided an aircraft on the first successful daylight cross-country flight by stellar inertial navigation. Another version

recently passed the Navy's exhaustive sea tests aboard the USS *Casper* Island in 1972. And in 1968, Autonetics' systems guided the USS *Northstar* and *Star* on their historic voyage under the polar ice.

Today Autonetics is producing to quantity the systems to guide the Air Force's *Gem-71* missile. Its engineers are designing systems for America's *Polaris* cruising subs and the *Minuteman* intercontinental ballistic missile. Even more advanced systems will provide the accurate stellar navigation data needed to guide man on his travels through Outer Space.

But the imaginative engineering that brought inertial navigation so far, so fast, is only half the Autonetics' story. New ideas had to be implemented by new manufacturing techniques. Many components of inertial navigation—gyroscopes, accelerometers and computer elements—called for precision that was once impossible. Now Autonetics has put it to the production line.

These are the achievements that have given here and now reality to inertial navigation... and have made Autonetics first in the field.

Inertial navigation

by Autonetics



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Says **CARL H. FOX**, President, Associated Radio Service Company, Love Field, Dallas



"This G-E 5-Star Tube is one of thousands we've recommended and installed!"

"Let us put them in all critical sockets!" We make that request every day to our customers. Five-Star Tubes get our strong endorsement because we know how dependable they are, and our experience includes every type of commercial plane—privately-owned, executive plane(s) or passenger or cargo airliner that may need emergency service.

"Associated Radio enjoys a wide reputation for installations and repairs of electronic equipment, and General Electric 5-Star Tubes helped build our good name. Flyers know they can depend on these G-E tubes in every respect. They do the full electrical jobs they're rated for, they outlast regular receiving tubes by a substantial margin."

"By recommending 5-Star Tubes, we serve the best interests of pilot and passenger—and cut plane maintenance costs as well. Refillable tubes keep planes in the air and out of the shop. Look at 5-Star Tubes from any standpoint—increased flight safety, more hours in the air, fewer electronic repairs—and they more than pay for themselves!"

Associated Radio's experience echoes that of major airlines, who report the same benefits from 5-Star high-reliability tubes. Your nearby G-E tube distributor stocks these superior types. Please Mail Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky.

Progress Is Our Most Important Product

GENERAL ELECTRIC



33111

present. Laboratory will lead up the new program. However, each of WADC's equipment laboratories will appoint a representative to a committee which will monitor the program and contribute ideas and problem areas for investigation.

Much of the basic research will be carried out by Westinghouse's Research Laboratory, Motorola Engineering Laboratory, and Semiconductor Division, but the company's Air Arm Division in Baltimore will lead up the program. This will insure the necessary crossflow of information between equipment designers and researchers and keep the program oriented toward specific mission objectives.

Combination of research and application effort also would stem around in the fact that Westinghouse Research Laboratory is now headed by Dr. S. W. Hersold who formerly was general manager of Air Arm Division in his former position. Hersold was a speech booster and one of the instigators of the company's molecular electronics effort in the mid-long-range hope for coping with mind-boggling complexity of a future computer and need for greatly improved reliability.

Model Shop

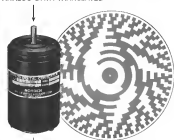
An Arm directly has set up in its Baltimore headquarters a Solid State Advanced Development Laboratory, under Dr. Gene Stull. It will serve as a model shop for fabricating complex of molecular electronics to meet special Air Arm equipment applications. The six laboratories provides a bridge between the basic research effort being carried out in Pittsburgh and the hardware personnel in Baltimore. Openly, the laboratory is a part of the Westinghouse Semiconductor Division at Youngstown, Pa., but is located in Baltimore because we want to put the device designer in a systems environment," Dr. Stull said.

Dr. Stull and his small staff of six circuit men, fully with Air Arm had some designs to learn what circuit board circuits are being designed where function might be performed in a single multitrack semiconductor and to in turn elaborate equipment designs in some of the novel molecular electronics that can be created.

The laboratory has been in operation for about five months, and is equipped to fabricate semiconductor devices in tiny crystals produced by Semiconductor Division. The light modulated oscillator demonstrated in Col. Lewis was produced by the Baltimore Laboratory. One of its current efforts is a low, solid-state, tapewitch, or counter, with no moving parts which can switch a control connection to any one of more output connections through application of suitable voltage which controls inter-

GUIDANCE SYSTEM?

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AMPEX increases signal/noise ratio

A real challenge to magnetic tape sensitivity comes with two-quadrant multiplexed data. It is here that the tape's signal-to-noise ratio sets mean values to achieve. The high levels of continuous unmodulated signals can build up modulation noise between channels and seriously affect signal output.

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Amper's FerroBlast tapes offer other critical improvements, too. A high degree of immunity to its interference and signal output greatly reduces signal distortion, further enhancing the signal-to-noise ratio.

Amper's FerroBlast tapes are available on 1/2 in., 5/8 in. tape and magnetic tape. FerroBlast tapes are available in 1/2 in., 5/8 in. and 1 in. standard on either 1/2 in. or 5/8 in. tape, in the following lengths, reel diameters, and tape thicknesses:

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REEL	TAPE WIDTH (in.)	TAPE THICKNESS (in.)
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5/8	5/8	0.001
1	1	0.001
1 1/2	1 1/2	0.001
2	2	0.001

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Rom. An Doppler VOR ground station transmits a 10 cps per second amplitude modulated variable phase signal which is compared with a 10 cps frequency modulated reference signal in the reference receiver to determine phase bearing to the ground station. In the new Doppler VOR, these two functions are interchanged with the amplitude modulated signal serving as the reference and the frequency modulated signal serving as the variable phase reference which indicates amplitude bearing to station.

Doppler VOR requires more elaborate antenna modulation than conventional coverage. Installation based in FAA used an array of 48 loop antennas equally spaced around the perimeter of a 1/4 in. diameter circle. Each antenna is necessarily excited by means of a connection with single surface RF energy which is 9000 cps, higher than the carrier frequency, producing the effect of a single antenna on a 27 ft area, not less than a speed of 1,500 rpm.

The station produces a Doppler shift of 180 cps, corresponding to the 48 cps frequency modulation, detection of the 9,000 cps reference employed in a conventional VOR station.

Because the frequency modulation is produced by Doppler shift due to apparent rotation of the ground station antenna, the FM reference (modulation magnitude) will change as the virtual angle between airplane and ground station changes. It will be a maximum when the aircraft is out at long range and low altitude, and a minimum when airplane is directly over station.

This has no adverse effect on airborne receiver determination of VOR bearing, zero error, and indicates it possible to determine the virtual angle between airplane and the ground station with an accuracy of approximately 15 deg at angles above 15

deg. In the case of a variable reference antenna connected across the reference receiver's FM detector. Voltmeter is substituted for maximum reading when VOR station is on the radio horizon. When the voltmeter reads 115% of full scale, for example, angle between airplane and station is 15 deg, or 60 deg when meter reads full scale.

Filter Center

• **Taken Vs. Troubles—Recent action** by eight leading vacuum tube manufacturers in forming an Electronic Tube Manufacturers Council to encourage, support and design to see tubes "which they offer superior properties" over transistors, may be a case of looking back over the fence after the horse is stolen. North four years ago, an Aviation Week survey of major tube manufacturers revealed that solid-state devices already had replaced tubes in 31% of the products of component manufacturers and that by 1977, more than 50% of the tubes were expected to be replaced by 1977. According to tube sales for 1976, more than 33% from the previous year while transistor sales were 64% higher than in 1975, in terms of number of units sold.

• **Voice of Experience—Human voice** that automatically serves pilot of such jet aircrafts, with him specifically what is wrong and what action to take, may replace the blinking light and warning horn now used to indicate an emergency situation. Automatic voice warning system under evaluation at Wright Air Development Center consists of 12 pre-recorded taped messages, each of 15 sec duration. Typical messages, in event of engine fire might be as follows: "This fire in number three engine. Check engine operation to verify if fire is present." Further number three engine. Fall number three engine fire shut-off handle. Fall number three engine fire extinguisher." Also was simulated by John W. Tuganoff of WADC's Aero-Aeronautics Laboratory. Prototype equipment was constructed by Northrop's Nondestructive Division.

• **New Type Transistor Converter—Which** for the semiconductor industry to bring out a family of new very high temperature transistors and diodes, capable of operating at temperatures up to 400°C, made of indium phosphide and gallium arsenide. Texas Instruments, Inc. has announced that the new silicon transistor circuit can operate at 321°C (AW No. 50, p. 31). New semiconductor materials are expected to yield transistors



World's Smallest Lamp

Two inch-long lamp, measuring only .001 in. in diameter by 1/4 in. long, developed by Amper's Diamond Division. Free Laboratory, measures only 40 m. in diameter at 1/4 in. making it suitable for use in computer flip-flop position indicators (AW No. 50, p. 31).



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When the National Aeronautics and Space Administration awarded the prime contract for Man-In-Space to McDonnell Aircraft Corporation of St. Louis, McDonnell specified that the escape rocket on the passenger capsule must have a reliability factor of .999. That is quite a challenge; but the Advanced Canopus Division of Grand Central Rocket Company was ready; its proposal was accepted.

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Kety engineers are working with manufacturers whose prototype systems have unusual environmental and accuracy requirements. Call or write for help in solving your special problems.



Division of United Aircraft Corporation

KEYAT DEPARTMENT, COMMACK, LONG ISLAND, N.Y.



Klystron Tube

Super-power Myktron tube has passed radio use at Lohnd has been successfully tested at peak power of 18 kw. with 225 kw average power load. General Electric, which developed new tube, says it is developing other models with higher power ratings and increased bandwidth.

with frequency response which is better than silicon, but probably not as good as germanium. Silicon carbide semiconductors, capable of operating at 500°C or higher, appear to be still in the future, although development of this area continues at a steady pace for the market.

• **Siged Co. Dotted Line**—Major contract already recently announced by various manufacturers include:

• **Melpac** will design, manufacture, and test for Project Mercury radiation stable, under subcontract from Cal Key Radio which holds various other subcontracts from McDonnell Aircraft which is developing the Project Mercury manned space capsule.

• **Spery Phoenix Co., Phoenix, Ariz.** contract for \$7.5 million from Air Force for remote guidance and control systems for Phoenix QF-80 jet drones.

• **Laboratory for Electronics, Inc., Boston** letter contract for \$1.6 million for AN/APN-105 Doppler navigation system. Final delivery contract is expected to be more than \$10 million.

• **Bedwin Instrument, Inc., 5195 50th** contract from Bendix Aviation for 30 data handling systems to be incorporated in automatic check-out equipment for Titan missile.

• **Minicore, Multin Electronics Division, Phoenix, Ariz., \$10,000** from Space Technology Laboratories for advanced telemetry receiver employing phase-locked techniques.

• **Callion Radio Co., Cedar Rapids, Iowa**, order for \$8.4 million from Marine Corps for AN/TRC-75 single side band systems for tactical field use.



Here is a man you should know he's a DELAVAN FUEL INJECTOR SPECIALIST

His name is Roger W. Tate. He did his doctoral research in the field of pressure atomization at the University of Wisconsin, has taught aviation mechanics, and worked on piston improvements for petroleum refining.

Dr. Tate is Director of Research at Delavan. He has developed many stressing devices and uniquely accurate test equipment for Delavan. He is widely known for his research on spray nozzles and fuel injection.

Specialized talent like Dr. Tate's is the main reason for Delavan's leadership in fuel injection. If fuel atomizing and distribution are part of your product, take advantage of Delavan's specialized experience and ability to deliver aircraft quality fuel specifications to the address below for free recommendations.

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Honeywell puts man in space —at zero altitude

**Advanced space environment simulator will isolate
two men in Honeywell-controlled space flight
environment during unprecedented 30-day test**

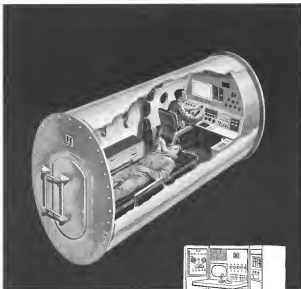
AS ANOTHER step toward man's conquest of space, Honeywell will provide the USAF School of Aerospace Medicine with an environment simulator for use in researching human reaction to isolation in space. The test capsule developed by Honeywell will hold two men and all the life sustaining materials they need for 720 hours. It provides a completely self sufficient environment contained in a 12- x 6- x 5 foot package. When man travels space, the air he breathes, the food he eats, temperature control, waste disposal, and all other basic elements must be precisely planned and controlled. This poses intricate problems involving toxic gas, altitude, oxygen, lighting, and many others. In solving them Honeywell utilizes advanced engineering techniques developed during more than 70 years of leadership in environmental control.

Honeywell Capability

Human environment, however, is only one of many fields in which Honeywell can demonstrate space flight capability. For example *Guidance and Submarine*. Honeywell's reference system

is a remarkably accurate means of attitude guidance and control *proven* in actual applications. *Flight Control*. Honeywell has more experience in the field of flight control than any other company. *Proven* systems include autopilots, reaction controls, jet valve controls, thrust vector controls and automatic landing systems. *Data Processing*. Honeywell capability includes sensing, recording, measuring and interpreting. *Ground Handling*. Some of the more extensive and complex work done by Honeywell is the attitude field centers the development and operation of test and checkout equipment. This work includes depot overhaul and maintenance equipment, base level overhaul and maintenance equipment, and launch site checkout equipment. Additional Honeywell experience includes measurements, auxiliary airborne power systems and research into human factors, both biochemical and psychological.

If you have a problem in the design of systems or components in the field of space flight, call or write Honeywell, Military Products Group, 2733 Fourth Ave., South, Minneapolis 8, Minnesota.



Two-man hermetically-sealed space cabin simulator. The basic structure of the simulator will contain equipment that would be found in actual space flight. Oxygen, carbon dioxide, toxic gases, temperature and humidity are constantly and individually sensed and compared to a set value. When safety limits are exceeded an error signal is emitted and corrective action is automatically begun. A sufficient water supply and facilities to reuse personal eliminators will be provided. Ample storage facilities for nonportable foodstuffs will be provided for the 30 day mission.



Extensive inside lights, pressure and oxygen data monitoring consoles inside the cabin. Personnel seats will be kept by radio monitoring, TV cameras, and camera equipment.

Honeywell



Military Products Group



REFUELED HAWKER HUNTER returns to underground hangar to be checked and made ready for the next scramble.



PILOTS AND AIRCRAFT of the 11th Division Fighter Wing's 1st Flight of four stand in the main gallery leading to the group (above) ready to roll on word from the control center. Ground crew manhandles a Hunter below, left. Training vehicle is loaded to main wheel. Planes are towed past way up ramp (below, right), pilot seat ejection seat vehicle run ahead of aircraft to runway.



AERONAUTICAL ENGINEERING



ROYAL SWEDISH AIR FORCE ML 16 Hunters of the 11th Division Fighter Wing at Tullinge take off on a scramble over their airfield, 15 mi. south of Stockholm. Wing comprises three flying squadrons, lettered to tell identity directly within a squadron.

Swedish Air Defense, Part 1

Swedish Planes Stand Alert Below Ground

By David A. Ascherson

At Base F15, Sweden—Pilots and planes of the Royal Swedish Air Force stand alert in the underground hangars below the deep strata of solid granite here.

The base, partly housed under the rolling land near Tullinge, 15 mi. south of Stockholm, is home for the 11th Division Fighter Wing (Kongl. Skydivisions 11gflyskvadron). This unit and the 11th Division Fighter Wing, stationed at Borlange, are assigned to the air defense of Stockholm. Both are equipped with Hawker Hunter ML 16 reconnaissance fighters. Since a few years ago, and now renewed with American Skyhawk reconnaissance fighters.

Deep under the tree-covered con-



IN GOOD WEATHER Hunters must activate the underground hangars on the battlefield 200.



For the Aviation Industry...

the big insulation news for 1959 is

JOHNS-MANVILLE FIBER GLASS

With L-O-F Glass Fibers Company joining the Johns-Manville family, more J-M representative can now supply excellent fiber glass materials for thermal and sound insulation in aircraft.

For pre-fabricated insulation—the same standards engineering and construction facilities of the newly acquired J-M plant at Corona, Calif.—are at your service. Backed by advanced research and starting with our own high quality insulating materials, the modern J-M machinery and skilled personnel can help you meet production schedules at lowest cost. Typical operations include: completely laminated fibered composite, preformed insulation panels, blankets with non-metal-

lic covering such as metal glass cloth and plastic film.

For high, medium and low temperature—*as example*, 1/2 inch of Thermax (F) rated glass fibers affords thermal resistance up to 2000 F. Built as listed, the non-hazardous, chemical-resistant, moisture-insulating with extremely low density and high thermal resistance is available in a half-inch or in the order of 2000 F equivalent, 3000 F insulation. Glass Micro-Fibers—1/2 inch faces—for service up to 1000 F (2000 F in some cases). Lowest cost Fiberglas F Fibers approaching the 3000 F level, now well within the range of a new, and at third-stage in "herding down" extreme temperature diff. module.

For aircraft noise-reduction—a complete

line of J-M Corfu-Aerotherm glass materials—pre-fabricated into blankets, frames and in or frame blankets—hand-cut, quilted or quilted with a wide selection of facing materials and finishes. In the aviation industry, as in many others, buyers of fiber glass products will now be served by an enlarged staff of J-M sales and technical personnel operating out of 50 city offices—by expanded distribution facilities—by the addition of 5 strategically located plants and by expanded research and development of fiber glass products. Call your J-M representative or write to Johns-Manville, Box 34, New York 10, N. Y. In Canada, Port Credit, Ont.

JOHNS-MANVILLE



ture air hangers and straps, turning out on long rollers. Six fingers on a dactylated hand, from here down to the feet of shallow straps coming down from 195's doorway.

Ranged in rows inside, faced and armed and ready to fight, are the dark green and gray Blanters bearing the three golden crosses of Sweden on their wings and fuselages. Oil in side galleries are guns, weapons, ammunition and a Hunter or two under maintenance.

Floor of the Blanters are lined up behind the blastproof door that shuts off the tunnel hangers from the outside world. Downward gear is attached to their nosewheel, and a wing is locked to the first in line. Other vehicles stand at the side of the hangers ready to tow the next plane in line. This will be the first flight to scramble from this entrance.

When the chain rings, ground crew run for the vehicle, move the first Hunter toward the opening door, and hook up on the next plane in line. Pilot, least from the passenger wing from the side room and let the plane ladder at a run from one side, face crew chiefs springing to the steps on the other side.

Check List

They call off the takeoff check list while the plane is being towed out of the door and onto the ramp. The crew chief supports fuselage, tank and other personal gear. Engines hit but and prop up. The pilot punches the engine master button and the Rally-Rover Avon starts a whine that grows to a shriek as the plane and its tow vehicle coast the ramp.

Behind them is another Hunter and a third and fourth, the distance between them on the order of 100 ft. All will have their engines running before they are clear of the ramp, and then the tow vehicles will break loose and streak up the tarmac ahead of the Hunters, turning off at the first opportunity and heading back to pick up the next flight.

When a number of a quartet or so, the first flight of four is hooked up and ready to take off. They scramble to pass, the Blanters clearing for altitude at the end of the 2,000-meter strip, banking up and over the tall conifers that surround the runway.

This is the alert-and-combat pattern typical of the units based beneath the surface of the two-coast arch of western Sweden.

This well-known base at F14, Mac others scattered through Sweden, like the red shatters in southern Ohio, and like portions of the South Aircraft Co.'s plant at Livingston (LAW 51), 1958, p. 64, was designed on the basis of early knowledge about the effects of no-



T-42 TRUCK replenishes loading point, replacing fuel down by aircraft after refueling.



P-51 HUNTER used to do portable fueling tank farm at station for a flight.



THREE B-29 HUNTERS stand by taking, at F14 is shown to keep for all engines and to accompany the plane. Several more in actual knowledge for the installation.

SCOTT ENGINEERS and U. S. AVIATION SCIENTISTS



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after a blast in one would be considered within that area and not cause damage to the other.

Each group of galleries has an entrance door, a heavy hinged structure that slides back into the surrounding granite. From the door, an inclined ramp leads up and out to the nearest gallery. This ramp is angled, and the entry points on either side of it form a bonded protection shielding the entrance from blast effects from almost any angle except, of course, directly in front.

The angular layout of the ramp protects the largest part of the hangar area also, and even a high-explosive bomb practically at the front door would cause minimal damage.

F18's underground base was one of the first and, in fact, lacks some of the complex systems being planned for newer bases and for the expanded galley base. For example, for extra-galaxy visitors will be installed in some bases, but F18 is currently with standard COA cuts at many locations throughout the work and storage area. Ventilation is simple in the F18 complex, but not enough to permit strong exhaust underground. Newer bases coming along will have air and huff systems that will allow engine starts while planes are still inside the hangar.

Pushy study rooms, shops and other auxiliary areas are also underground.

Perhaps the closest comparable situation is a modern aircraft carrier. To the observer, the comparison between those lofty well-lighted work areas under ground and the hangar deck of a modern carrier is surprisingly apt.

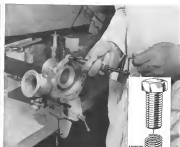
F18 at Home

The 18th Wing, commanded by Col. E. G. Nash, is typical of all the units at the Royal Swedish Air Force, and F18 is a typical base. It's an operational base only, there are no family housing units, post hangars, shops, headquarters building, barracks, a small BOQ for duty pilots standing alone, and more halls.

Base at F18 Sweden Sweden's current officers and enlisted men live on the economy and off the base. Total personnel attached to the wing is approximately 700-800. Figure that increases substantially in wartime.

Organization of the wing is also standard for the USAF. There are three flying squadrons and one ground squadron to handle support, mail, debris and base housekeeping. Squadrons designate as follows throughout the USAF. The three flying units are called No. 1 (Fly), No. 2 (Fly) and No. 3 (Fly).

Planes within the squadron are identified by a single letter painted on the squadron color on the vertical tail. Radio identification for each plane is



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the day fighter action increasingly clear. It is significant. Only all-weather systems will be of any real value in a future conflict.

For this reason Sweden is pushing production of the Saab 37 Viggen (AW Mar 24, 1978, p. 40), a single-seat all-weather interceptor capable of Mach 2 in level flight and armed with four U. S. Navy-developed Sidewinder infrared homing missiles.

The little double delta is to replace the aging Saab 37 Viggen fighters that have been recently operational with effectiveness.

After these, the Harrier will be in good, perhaps, by JTF Doctrine or perhaps by market.

But though these day fighters will have seen their day, their underground bases will still serve. They could house attack wings, or they could house mobile air-to-air refueling, and stand the new expense of providing lead bases of a different design for a new family of photon aircraft.

Either way, the strength and utility of these suburface galleries, blasted out of the tough ground by heavy, rugged lighting drills, will continue to underlie the technical foresight and creative engineering abilities of the Royal Swedish Air Force.

XV-3 Convertiplane Completes Gear Shift

Fort Worth-Bell helicopter XV-3 convertiplane has completed its first gear shift in flight, an advance which permits the VTOL aircraft to cruise more efficiently in the supersonic realm.

High rotational speed which enables the XV-3 autogiro rotor to lift the rotor during descent is too fast for efficient cruise after the autogiro has been converted to forward flight.

Gear shifting, reduces rotational speed by 40%, allowing the autogiro to revolve more slowly and take a deeper bite.

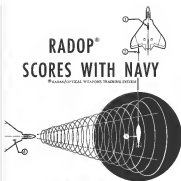
Shifting is done in the main transmission with a clutch system. It has been done several times in wind tunnel runs, and now has been accomplished in full forward flight.

Use of a free turbine powerplant, in place of the present piston engine, would simplify the shifting operation if such an engine should be included in the XV-3 aircraft program, Bell engineers said.

Bell XV-3 has made several full and partial conversions since the first conversion was made (AW Dec. 18, p. 24). The convertiplane has made three full conversions above 10,000 ft, which Bell says is above the altitude capability originally expected for the aircraft.

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Del Mar Engineering Laboratories' Radop Weapon Training Systems are used extensively in the training of U. S. Navy pilots. By firing radars and missiles at computerized Radop Test Targets and by using Radop Scores to measure miss distances in three dimensions, the Navy saves U. S. taxpayers millions of dollars and introduces a higher degree of realism into training than is possible with other more costly systems.

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4. RADOP SCORER — First unit to obtain miss in picture and radar track angles to provide a positive measurement of miss distances during rocket firing runs.

For more information on Del Mar Radop Systems, write for Data File AD-139-5.

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Flying Crane Shows Load Carrying Uses

Sikorsky S-60 flying crane, being flown by command flying pilot (above) completes hooking sequence before hoisting a mockup of the Army's House of the Future. Ground crewmen with the pilot with signals and actually carry the hook to the limit. Two-ton telephone pole (below, left) and 4,500 lb. bridge section (right) also are carried.



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Applied to inventory control, production scheduling, sales forecasting, and cost control, this new method brings tighter control and substantial operating savings. Now, new techniques such as job shop simulation become practical and enable you to look into the future with a minimum of trial and error.

Typical results of the application of this IBM method. One

manufacturer does a complete monthly material requirements breakdown for the next twelve months in just twelve hours; service parts production is calculated in just one hour; per part inventory updated on a daily basis in one hour. Other controls include weekly machine load forecast and summary inventory evaluation reports.

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Potential of Ground Effect Vehicles Studied by Defense Department

Washington—Increased interest is being given to the military potential of ground effect vehicles that ride on cushions of air (AVR Jan 12, p. 74). Defense Department officials recently told the House Committee on Science and Astronautics ... Lt. Alexander Duguid, Director of Defense Research and Engineering, and others emphasizing the research interest include:

- "Technological competition exists on the East and the West that demands the investigation of air-cushion phenomena that might improve our military and economic status."
- "Capability of an escape to use nuclear weapons in any kind of conflict will require dispersal of satellites and a whole concept of troops. Consequently, one armed force must have a reach greater degree of mobility than ever before."
- "Possibility that First World forces will have to fight on less developed areas where inadequate transportation systems exist. This factor again indicates the need for increasing the mobility forces and reducing their dependance on such prepared facilities as roads, airfields, water and port facilities."

Possible Uses

Marine and the use of ground-effect phenomena by air vehicles can be classified in the following categories:

- "Conventional airplane and helicopter and their many sophisticated vertical takeoff and landing derivatives that take the transition through ground effect very rapidly and make little or no benefit use of the ground-effect phenomenon."
- "Aerial vehicle type of VTOL aircraft that operates within the ground cushion in a vehicle riding on air but, after obtaining a minimum velocity, becomes so an aircraft and is supported by aerodynamic forces generated by its forward motion."
- "A vehicle ground-effect vehicle that operates at all times within the ground cushion over open land or sea area. The movement of this vehicle is not restricted to land, sea, or air or other similar surface elements that impede the movement of wheeled vehicles. Military interests center around this category."
- "A vehicle that operates on the water-borne concept. Interest with our force becomes significantly reduced in a thin film of air between the vehicle and the water."

Marine and the Defense Department is now conducting the research and development activities of the series in order to provide an understanding of the phenomenon.

A detailed review and analysis of the phenomenon is scheduled to be held only next month at Princeton University. General Alexander Duguid said, in the view of Alexander, an interest in ground effect vehicles on the sea being contemplated in the West is placed.

But, Alexander Duguid, chief of naval research, told the committee that the Navy also can finance a number of possible uses for such vehicles, including as amphibious transport or as a small boat that would travel faster than the sea. The view at a speed of 50 mph and be capable of negotiating beaches with slopes of up to 15%.

Another possible use, Alexander Duguid said, would be as an amphibious warfare. He said studies are being conducted which may have a vehicle on a platform that can ride high enough to clear the waves and travel 20% faster than nuclear-powered submarines. The vehicle, he said, must be capable of floating on the water for extended periods and be equipped with automatic blowing and sucking facilities so that it could sink, cut in enemy resistance, hover over the top and drop a bomb and then move out to avoid enemy observation or attack.

Will another possible use, Alexander Duguid said, would be an amphibious transport—on a small ship platform 1,000 ft in diameter that would be capable of speeds up to 150 kt and operate 50 ft above the water.

Status of Programs

Here is a report on the status of Navy programs to explore the possibilities of air-cushion vehicles as suggested by Alexander Duguid:

- \$40,000 contract with the Aerojet Corp. to conduct detailed theoretical analysis of the flow processes in the ground effect in both hovering and forward flight and to conduct theoretical and calculations of possible experimental results.
- \$21,000 contract with the University of California to test small models over water at varying forward speeds, and different simulated wave conditions are recently signed.
- \$10,000 contract with the State University of Iowa to study the influence on performance of changes in various geometric parameters. "Small model ground and water table tests is in progress."
- \$2,500 contract with Swiss designer

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• \$100,000 contract with AeroSpace Laboratories of David Taylor Model Basin to machine, disassemble and build test models in wind tunnel under consideration

• \$80,000 contract with Grumman Co. to construct and test video and change characteristics of new carrying method bearing machine of about 50,000 diameter in aircraft in progress and first flight test is expected in August

• \$30,000 contract with Canair to build design feasibility of a new large flying vehicle for over water operations employing aircraft engine structure and the possibility of employing a nuclear power source has been suggested

• \$50,000 contract with David Taylor Model Basin Hydrodynamic Laboratory to construct and test models of various ship type vehicles in a towing tank, but have started as a first phase program

Eng. Geo. F. H. Barton, director of development in Office of Chief of Armory and Development, said the Army has been carrying considerable effort over the past three years to develop what he termed maximum ground pressure vehicles to operate around town and over rough terrain. He said it is essential that such vehicles be able both to hover or move in ground effect and to fly at altitudes of at least 50 to 100 ft.

Gen. Barton told the committee that the Army is now moving toward the use of aerial vehicles as actual replacement for ground vehicles in combat units.

After the Korea War, Gen. Barton said the Army began experimenting with the H-100 flying platform. While it was not suitable for Army field use, he said, it did illustrate the possibility of using the ducted fan principle in larger vehicles which might be more suitable for use in the Pacific. Such flying vehicles, which might lead to a suitable vehicle for field use.

Gen. Barton said two similar projects are under way—one by AeroSpace Development Corp., a subsidiary of General Motors Corp., also called by General Motors Corp. All projects utilize different techniques for stability and control. Another feasibility study is under way at National Research Associates. One project he said, that program is to offer a possibility of carrying vehicles in the Air Force, a joint Army-Air Force sponsored program with Aero Aircraft Ltd. of Canada. He said the development is now in advanced stages and that ground testing should begin soon.

Wood, and testing on a number of other vehicles will be finished in 1950, Gen. Barton said.



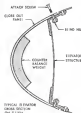
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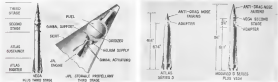


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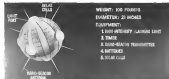
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NASA Plans Scientific Satellite Shots



A diagram of a house with various parts labeled. The labels include: ROOF, WALLS, FLOOR, CEILING, DOORS, WINDOWS, BASEMENTS, ATTIC, PORCH, DRIVEWAY, GARAGE, and POOL. The diagram shows a cross-section of a house with these parts clearly marked.



AVIATION WEEK April 17, 1999



a. Titanium alloys are heated prior to rolling into extrusions that Crucible's increased capacity for producing high purity metals, in all sizes and wall forms, is substantially reducing costs and delivery times.

b. Vacuum Melted Alloys are specified for gas turbine parts used in high speed jet engines. The metals' improved properties facilitate reversioning.

c. Titanium helium storage bottles for ICNAT Atlas-Titanium, which must be vacuum melted, was selected because of the high strength, weight ratio, and corrosion resistance.

d. Basic Melted Process. Vacuum induction melting produces "pure" metals than conventional air melting because it eliminates all sources of contamination except the metals. Vacuum re-melting eliminates the crucible and permits production of ingots up to 10,000 lbs.



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perience, together with its extensive facilities, places the company in the best position to provide the "super-quality" metals most suitable for any given application.

The three vacuum-melting processes—One of the Crucible processes is VIM—vacuum induction melting. It starts with very high purity raw materials, produces extremely pure ingots. A second is VAR—vacuum arc remelting, or the consumable electrode process. This process, starting with air-melted electrodes, produces large ingots—up to 32" diameter x 10,000 lbs. It provides

SUPER-DUTY METALS

metal with low gas content and greatly improved uniformity of properties. The third process is VRR—vacuum arc remelting of vacuum induction melted electrodes—a double-melting technique. It permits manufacture of super-pure metals in the full range of ingot sizes.

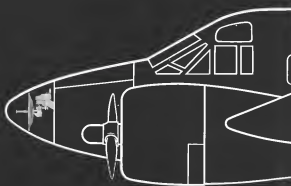
Crucible's experience with all three processes, and its facilities for vacuum arc remelting to even specially air- or

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TAB, nosepiece of the Mooney Mark 20-A covers its true purpose. Cow head is 9 ft., 8 in. Mark in this aircraft is shaded by lens action of the gas compressing rubber doughnuts. Ground and air velocity is good.

Aviation Week Pilot Report

Mark 20-A Shows Good Aileron Control

By Robert I. Stauch

Dallas-Mooney Aircraft's single-engine, four-place Mark 20-A is a high-performance "ultralight" airplane that shows excellent stability and control from a cruise speed of 185 mph through slow flight and power-off stall at 55 mph.

The Mark 20-A is powered by a four-cylinder Lycoming C1600-A1A rated at 150 hp at 2,700 rpm at takeoff. Propeller compression ratio is 8.5 to 1. Fuel gauge is 56 ounces. The McCauley propeller is constant speed and, with spinner, is all metal. The governor is a Woodward.

Laminar flow wing and empennage are constructed of pressure-bonded, laminated aircraft spars. The fuselage is all metal. Minimum ramp weight is 555 gal. of fuel, in 760-oz. tank. With an optional 14-gal. fuel tank installed, range is increased to 1,875 mi. Cost of the standard Mark 20-A is \$14,590.

Performance characteristics evidenced during flight evaluation by Aviation Week included:

- **Takeoff and climb:** Grossing about 2,142 lb., at an elevation of 642 ft. into a 2 kt. wind, the Mark 20-A was pulled off at 60 mph after 900 ft. of roll. Initial rate of climb exceeded 1,800 fpm. At 180 mph indicated and 1,980 fpm, the airplane accelerated through 1,580 ft. at 500 fpm, 6,000 ft. at 600 fpm.

- **Airline control:** No rudder was used during slow speed maneuvers at 60 mph, indicated, climb, and 68 mph, duty (gear and flap flap), at 7,000 ft. The ball remained centered during moderate and steep turns controlled only by ailerons. Flapsetting was discontinued at 60 mph, at 80 mph the

airplane could be trimmed head-off in turns.

- **Stall characteristics:** Steady half-groove climb levels—accelerated from stalls in climb and duty configurations at 7,000 ft. There was no tendency to roll off on the wing, control was entirely by ailerons. Climb, pulling 14 in. mani-



INTERIOR view of the Mark 20-A emphasizes empty cockpit. Cow handle, linked control on instrument panel, folds back with the floor, between the seats.



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field pressure and 2,100 rpm, the air glass, stalled at 60 mph and built back down at 500 rpm. In landing configuration, fuelled and porpoising down came between 50-55 mph indicated.

• **Straight and level speeds:** At 3,000 ft., pulling 12.5 in. and 2,400 rpm—about 73% power—the Mark 38-A was cited 135 mph. With outside air temperature 60°, the airplane, trimmed out at 351 mph. At 12.5 in. and 2,400 rpm—about 65% power—indicated speed rose 174 mph for a true speeded wind rose of 176 mph.

The Mark 38-A is a smart looking airplane. Its laminar flow wing, the nose and all fuselage are covered with yellow paper, a hardboard plywood which is varnished so there are no rivet chambers.

The main spar is made of 5054 spruce. It is laminated with surface polyurethane glass which adds 150% to the strength, according to Moscov. The entire wing is mounted on a rail of synthetic rubber, where both interior and exterior look up seven gillows of this material. The objective is to control the flow of motion, during dry and wet seasons and to prevent both dry and wet rot.

Fabric Coating

Acrylic fabric is applied with one coat at three days intervals by its more coats. The fabric is three-ply with two coats of silver and three coats of white dye. The next application is of two-coat varnish dye. Moscov says the life of the wing should equal or exceed that of the metal fuselage.

Lack of concern about wing bending was apparent when, before flying the demonstrator, three persons sat on the wing, one sat on the stabilizer. The strength of both was evident at this point.

The baggage door, on the right side, of the fuselage aft of the cabin, opens to a 120-lb. baggage compartment. The door is air and water-tight through a full-length piano hinge, mounted on steel and rubber molding.

Behind the baggage compartment is the radio equipment area. A removable control panel on the tail cone allows direct access to the power supply, rack and other necessary equipment.

The whole of the tail cone is movable for true purpose, when the elevator is raised back the entire tail cone can move. This design adds to stability at low speeds and allows for maximum drag at high speeds.

The airplane is entered via a retractable foot step opening midway down the landing gear station. The step retracts completely into the wing fairing, eliminating drag. The cabin, complete with side entrance (optional), was comfortable and roomy. The foot



RAMB of the Moscov Mark 38-A, with 49 gal. of fuel, is 1,675 in. Maximum cruise speed is 140 mph. Service ceiling is 20,000 ft.

step adjust fore and aft to three places.

Flight instruments are on the left side of the shock-insulated instrument panel. Radio controls are centered. Engine instruments are located to the right side. Landing gear, wing flap and aileron flap controls are located directly below the center panel. Two main tanks hold 175 gal. each. The optional 14-gal. aux tank costs \$200. The demonstrator flew in Anacostia, Wash., N10488, had but two hours of

flying time. Empty weight, with equipment, was 1,455 lb. With four persons aboard, plus 34 gal. of gasoline and 38 lb. of baggage, the airplane grossed 2,352 lb.

The engine fuel up quickly and so called out to ramp. Variables in this three-gear airplane is good in the air and on the ground. The windshield is of tinted plastic glass, strong and transparent as all Moscov. The wide gear makes for good ground handling characteristics. Shown in a Mark 38-A is absorbed by knee action of the gear compressing rubber shock absorbers.

The variable nose wheel has to be added pedals. All baggage to control sideways is push-pull (horizontal).

The propeller and magnetos were checked at 1,800 rpm. (The reverse throttle is intended for power adjustment) and was ready for takeoff. Elevation of Red Bull Field is 642 ft. Wind was but 2 kt. Outside air temperature was 77°. Sea level pressure was 29.75 in.

First Takeoff

The first takeoff was "normal," the airplane, at full power, accelerated to 60 mph when the nose was pulled up. Right back pressure is required on takeoff due to the negative angle of the airplane in roll. The Mark 38-A flew right off at 70 mph. (During a subsequent short field takeoff, full flaps were dropped in the airplane got rolling to 45 mph. In this manner we were airborne in 300 ft. at about 60 mph.)

Power reduction for climb-out was to 2,500 rpm, following retraction of gear. The gear is retracted manually (as are the flaps) and can get up or down in only two to three seconds. The retractable flaps, Moscov says, eliminate the need for separate electric or hydraulic actuators and cut costs.

The gear handle is a long bar extending from the floor between the front seats. With gear down, the handle locks in place under the center seat.



WING of the Mark 38-A is constructed at present loaded, insulated shock absorber. The completed trailing edge is only for yellow paper plywood surface.

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Mooney Mark 20-A Performance

Maximum cruise speed (95% power at 6,500 ft.)	350 mph
Top speed (100% power at sea level)	390 mph
Maximum cruise speed (95% power at 18,000 ft.)	364 mph
Stall speed (nose high, down, power off, sea level)	57 mph
Rate of climb (100% power at sea level)	3,150 ft. per min.
Takeoff run (20 mph, wind, sea level)	480 ft.
Landing run (40 mph, wind, sea level)	575 ft.
Service ceiling	2,800 ft.
Absolute ceiling	22,000 ft.
Range (full av., 16 min. reserve)	
Normal (55 gal. fuel)	670 mi.
Maximum (50 gal. fuel)	700 mi.
*Normal (49 gal. fuel)	900 mi.
*Maximum (49 gal. fuel)	975 mi.

*Engines: Lycoming five cylinders, Model 9568 rated 180 hp at 2,700 rpm

*Fuel: 80 oct. McGowan, 74 in. vent, constant speed, convertible pitch

*Auxiliary fuel tank of 14 gal. is optional item

strapped panel. To ease the gear, the up-lock is released with the finger, then the handle is pulled back and down to one movement into a locking device flush with the door.

The handle handle comes back from the panel about 12 in. with very little pressure; thus a sharp pull is necessary to get it through the "hard spot" that activates the mechanism spring. The mechanism is one that requires a few applications for smooth operation.

Normal climb was made to 7,000 ft., looking 2,500 rpm. The engine was leaned to cruise. Speed in climb was 160 mph indicated. Rate, in sea level cruise, was 800 ft. at 2,500 ft., 600 ft. at 6,500 ft. Climb angle was good and the airplane was trimmed for hands-off flight during ascent.

Noise Level

Noise level was moderate through climb and succeeding phases of flight. Temperature level was comfortable; the airplane is equipped with a vent and exhaust system. A battery in conditions, an evaporator cooler type which holds 5 qt. of water, is available as an optional item.

Climb was configured a few hundred feet beyond cruise altitude, the gear was dropped and the aircraft put in a shallow dive to get it "on the step." At 7,000 ft. with outside air temperature at 60°, cruise speeds varied from 351 mph (true airspeed) at 73% power to 386 mph (TAS) at 94% power.

Adverse control was meted through out this flight. The airplane was easily flown hands-off on turn, with the ball holding to the center. Control again was evident during still descents. Sudden loading over the wing root, also, the outer portion of the wing to keep flying when the root has stalled. The Mark 20-A was stalled close and dirty, full flaps and full flaps, power

off and power on. At best we could get a steady buffet and porpoising, and stall speeds varied with power and engine RPM. From 30-55 mph in landing configuration, power off, to 60 mph (climb) pulling 14 in. and 2,300 rpm.

Stalls in the Mark 20-A run in building and porpoising, the airplane is quite docile. There is no wing drooping and no rattle application is necessary. Another aid to slow-flight stability, is the 21 ft. of flap, which spans 70% of the 55 ft. wing span. Flap control is three-position—quarter, half and full.

With gear and flaps up, the Mark 20-A has a 15 to 1 glide angle. The zero-zero demonstrated when, at 4,500 ft., about 3 in. out of the field, the engine was pulled to idle cutoff, gear/pull control was brought full back (in time to full feathering as possible,



BAGGAGE compartment of the Mark 20-A has 120 lb. capacity and is both air and water tight with a half-length power lever assisted corner and rubber molding.



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HOW TO MOLD HEAT-STABLE LAMINATES WITH DOW CORNING SILICONE RESINS

Complex parts, such as hot air ducts and radomes, can be made easily with Dow Corning silicone laminating resins. Finished parts are lightweight, and retain high strength after prolonged aging at 500 F. Silicone-glass laminates have excellent wet electrical properties and low dielectric losses at radar frequencies. They can be drilled, machined, sawed or sanded. Here is the step-by-step procedure for vacuum bag molding of silicone-glass laminates.

STEP 1

Pre-impregnated glass cloth is hand laid to a form. The form can be made of metal, plaster, or any heat-stable material. When necessary, the cloth is tacked in place with a tacking iron. The pre-impregnated cloth has good drapage and can be used to make complex parts.



STEP 2

The lay-up is surrounded by bleeder cloth, which allows even distribution of the vacuum.



STEP 3

The lay-up is surrounded by bleeder cloth, which allows even distribution of the vacuum. The bag is then sealed, and the whole assembly placed in an oven. The part is cured through 350 F.



STEP 4

Following the final cure, the bag and bleeder cloth are removed. The part is then aftercured through 400 F, trimmed, and finished. Complete operation is simple and economical.



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Mooney Mark 20-A Specifications

Displacement	35 lb.
Wing span	23 ft. 2 in.
Length	8 ft. 4 in.
Height	9 ft. 1 in.
Area	
Wing	357 sq. ft.
Adverse	111 sq. ft.
Floor	171 sq. ft.
Radical stabilizer	75.5 sq. ft.
Elevator	32 sq. ft.
Stables	73 sq. ft.
Vertical fin	1 sq. ft.
Weights and loadings	
Maximum gross weight	2,400 lb.
Empty weight	1,400 lb.
Useful load	1,000 lb.
Maximum baggage capacity	320 lb.
Usable fuel capacity (two tanks)	35 gal.
Wing loading	147 lb./sq. ft.
Power loading	15.5 h.p./sq. ft.
Wing Low position, fully cantilevered wood construction, modified laminated. Doors employing NACA air form (41 415 at tip and 402 215 at tail).	
Protege: Cable reinforced tube laminated aluminum covered Aft section. —Aluminum monocoque frame. Encapsulate Wood construction, adaptable to trim.	

and the switch turned off. Initially we had some doubts about making the field, but we went over it well on the high side. Holding an indicated air speed of about 100 mph, the airplane had a very flat glide. Rate of descent was 500 fpm. With gear and flaps down, the glide angle of the Mark 20-A is 9.8 to 1.

The engine was brought back on and the airplane slowed to 50 mph indicated airspeed after the gear was dropped. This speed was held while turning on to final approach, and upon the high glide ratio was evident. It wouldn't be hard, with the flat glide, to



ACCESSORY equipment such as baggage compartment, provides access to cargo ports supplies in Mooney Mark 20-A.



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on about the first time around. The engine was brought over the line at 78 mph, the landing run appears to be 500 ft. A short-field "dog" approach, holding 80 mph with power, will result in a one stop within 160 ft. Once sitting on the runway, an eight engine airplane is necessary for some straight control.

Mooney's current production at its Kewanee, Ill., plant is all Mark 20-A (the company is no longer building the 193-hp Mark 20). Production is at the rate of one a day, or about 240 a year. Sales are currently heated cash, by production. Dick Martin, sales manager, told Aviation Week.

1960 Model

The company also will introduce the Mark 21 as a 1960 model, with serial production coming in the fall and serial deliveries scheduled for November or December (at Mooney's annual convention).

The Mark 21 is essentially a Mark 20-A powered by a four-cylinder Lycoming O-540-A, 230-hp engine. The prototype is scheduled to handle higher speeds and higher gross weight but the general dimensions are unchanged from the Mark 20-A. The exception is the nose, which is eight inches longer to handle the bigger engine. The airplane



MAINTAIN air conditions shown in its stalled position, is evaporator cooler type and holds 5 gal. of water.

will be on the \$18,000 and up price ranges.

A third model, the Mark 22, is scheduled for introduction in 1961. This is a light twin with the general Mark 20 dimensions, but with two 150-hp engines.

Mark 20-A total operating cost per hr., according to Mooney, runs to \$12.17 for 200 flight hours per year. \$12.81 for 300 flight hours, \$13.73 for 700 hr., and \$9.37 for 1,600 flight hours per year. Cost per mile, with cruising speed of 175 mph, is estimated

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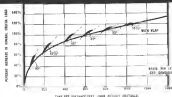
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at 101 costs for 100 lbs. 114 costs for 500 lb, 6.1 costs for 700 lb and 5.2 costs for 1,000 lb per year.

The Standard Mark 20-A is built with equipped. Optional areas, at all altitudes, include packaged radio units, full-sized instrument installations and miscellaneous items including dual controls for 500 and a Gnomes system for 5150.

The demonstrator flow was equipped with Minuteman Superhose (VHF) by South VHF transmitter with 122.1, 122.5 and 122.8 crystals, VHF receiver, ocean wave and indicator, headlight and microphone. The package costs \$610. Full-sized instrumentations, costing \$155, includes an engine-driven vacuum system (distillation) box, horizontal gyro, clock and status page. A 12-v battery and 15-amp generator are standard with the Mark 20 series.

Private Operator Buys First Ag-Cat

Colerain, N. Y.—Continuum Aircraft Engineering Corp. has sold its first Ag-Cat crop duster and spray plane to a private operator who had been called in during development to evaluate the plane.

The first Ag-Cat went to Allan Rubin, operator of Rubin Air Service at Accord, N. Y. Rubin will use the plane, which is convertible to both spray and duster, on orchards, row crops, mosquito control and fertilizing.

Ten Ag-Cats have been built for Continuum by Schweizer Aircraft Co., at Elmira, N. Y., according to Rubin. More Ag-Cat sales manager Schweizer will put the plane on an eight-to-eighty production schedule, starting early in May.

The Ag-Cat costs about \$15,000 equipped with a Continental W-670 engine of 180 hp. The plane, however, will be sold for about \$16,900 if the purchaser furnishes his own engine and propeller for installation on the production line.

More than Continuum will make good trouble payables in financing, probably through note endorsement, but final financing plans have not been made. He and the company probably will not be interested in lease-back arrangements in Connecticut, but will give the airplane its first public demonstration, operating a 2,500-lb. swath at Colerain Field, just south of a water tower, manure, water and water, a fertilizer developed by Allied Chemical Corp., called Urea 33.

The aircraft was flown by Continuum pilot Elmer DeMora at altitudes from 510 ft and speeds of about 25 mph in a turn (continued) DeMora made his own turn at altitudes of about 100 ft, turning 180 deg. in time more than the



Yak-12A for Aeroflot

Class passenger Yak-12A, a lighter performance version of Yak-12M, has completed its test program and will be used by Aeroflot for local service. Powered by a 140-hp, multi-cylinder, inverted engine, the Yak-12A has maximum range of 425 mi. compared to Yak-12M's range of 297 mi. Cruise speed of the former model is 110 mph, compared with 99 mph for the latter version. Top speed is reported as 134 mph. Design change includes single strut wing brace (Yak-12M has V strut), several structural cutouts, use of a control wheel instead of a stick, revised instrument panel, additional side windows in the cabin and an improved cabin heating and ventilation system.

plane's sides. Earlier this day, the Ag-Cat had completed delivery of 490 acres in a lot less than 4 hr. Air traffic equipped 15.5 gal. per acre in high depth spraying. DeMora landed several times to reload his hopper and usually was off the ground again within 5 min. The Ag-Cat was loaded from a Continuum tank truck which used an auxiliary pump located behind the tank.

Ag-Cat carried about 3,000 lb. payload in the hopper, located immediately in front of the pilot's cockpit on the sloping nose section. A fixed down motor, along beneath the engine, provides 30 psi. pressure to the hopper. Hopper is built to prevent shoving and burrowing. It is rated to 24 open models located beneath the lower wing. Before was developed for Continuum by Spraying Systems Co., of New York City.

Continuum is doing sales less than 45 min.

The Ag-Cat recently completed an extensive line of Latin American design and spray operations and DeMora said operator reaction was excellent. "Aircraft handled well in South American climates and sales pitch probably will be directed toward those countries."

Jared Kosi, assistant sales manager at Elmer, said an Ag-Cat will be displayed and demonstrated at the French International Airshow at Paris, June 12-21 in open to a European sales campaign.

Airplane is 24 ft. 9 in. long, has a gross weight of 3,740 lb. and empty weight of 2,178 lb. (AW No. 12, 1958, p. 11). At maximum gross weight, stall speed is 67.5 ft.

Avionics Engineers

New projects at the Columbus Division have created openings for electronic engineers and scientists in many fields.

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Helen Johnson, company, Minneapolis, has ordered a Nicom-Solstar MS-700 for plane repair; license plans from the manufacturer to be used in transporting equipment.

Delbert Farwell delivered the sixth vintage version of the F-27 helicopter to the National Co., Inc., Newport News, Va. 49th Beech Super 18 has been delivered to H. L. Noble Construction Co., Green Hills, N. C. 1800th Comet 318 and first 1955 model 318C was delivered to Shipley Marine Manufacturing Co., Akron, Ill. 1500th 318V VVIP transport service was delivered by National Aircraft Corp. (Newark to Van Dusen Aircraft Supply, Yonkers, N. Y.)

Helicopter dealer Philadelphia Helicopter Services, Inc., Valley Forge Airport 26, has been named Major Aircraft Corp. dealer for Philadelphia, Delaware, Maryland and Washington D. C.

Van Dusen Aircraft Supply established a warehouse district with two new salesmen and offices at Longwood, Dallas, Tex. Manager is Donald R. McGinnis.

More than 400 students, in addition to representatives from airlines, radio-TV stations, and private flight operators are expected to attend the annual meeting of National Intercollegiate Flying Assn. being held May 7-10 at University of Illinois Airport near Champaign.

New Speed Record

Las Vegas—Walt's speed record of 326.148 mph was set here over a 1.2427 mi course by Matt Jones Cobb on an Aero Drag 400 E. Two-engine turbine airplane. Matt Cobb, right, which broken a 321.715 mph mark set by Soviet test pilot Zakharov in a TB-11 in 1915, has been scheduled to take the Aero Drag 400 E to the end of the runway (1W Mar 25 p. 91) 41.8 speed record was from McGinnis Field, Las Vegas to Pasadena, Calif. to San Diego and back to Las Vegas.

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The Columbus Division of North American offers immediate positions for career-minded structural engineers.

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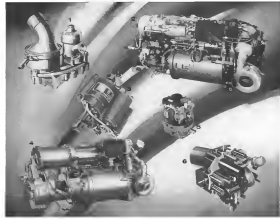
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Radioplane Develops Mercury Parachute



MODEL shows how capsule is positioned on approach. After air normal, spin capsule. Upper structure is emergency escape tower.

Las Vegas—Details of the two-stage parachute system which will slow Project Mercury's manned space capsule for a safe landing after re-entry from orbit were unveiled to the World Congress of Flight here by Thomson Research, Inc., head of Northrop Corp.'s Radioplane Division, Pasadena-Calif.

French-made Group is developing and developing the landing system for McDonnell Aircraft Corp.'s capsule structure for National Aeronautics and Space Administration.

Preparation for landing will be initiated either by pilot or ground control stations using radioaltimeters to decrease capsule's velocity and prepare the re-entry trajectory.

At 60,000 ft altitude, the automatic chute system will be initiated by deployment of a drogue chute equipped from a master triggered by dual altitude controls. Drogue chute will provide stabilization for the capsule and system attached until the capsule descends to 10,000 ft, when it will be released by automatic altitude controls (AW April 20, p. 28).

The main landing chute will then be deployed and will provide an impact velocity of 30 ft/sec when the capsule reaches 1,000 ft for its final landing. Upon release, the drogue chute will be released and various recovery and landing aids, such as GPAR bombs, ejection seats, radio beacon flashing light and attitude signals, will be ejected.

Reserve System

In addition to the automatic sequence, the landing system will incorporate an independent reserve landing system which will be able to be operated manually by the capsule pilot.

Feasibility of establishing world-wide telephone, television and telegraph communications with a "24 hr." satellite orbiting 22,800 mi above the earth was reaffirmed by Donald M. Collier, director of International Telephone and Telegraph Corp.'s Marine and Space Services Laboratories.

The type of system would be feasible in the near future, more, Collier's technology Collier declared. Two principal problems would be development of reliable satellite-based equipment with high transmission output and adequate electrical energy, and development of a guidance and control system for the ascent and orbiting phases he said.

Collier's concept envisions three of the satellites 120 deg apart positioned alternately with respect to the earth be-

cause orbiting speed would match that of the earth's rotation. Three ground station stations he cited as examples were Houston, Tex.; Aden, Yemen; and Tokyo, Japan, to provide almost complete global coverage. Only limited areas around the polar regions would be below the line-of-sight horizon for the satellites.

One configuration of a 24-hr. satellite orbit as an example would be a 4-ft-diameter cylinder 7 ft long, weighing 400 lb, incorporating a 15-in. antenna dish and affording a 90-sec orbital cycle. Solar energy collectors for storage batteries would be located in the periphery of the cylindrical surface. Propellant jets would control the vehicle's orientation.

Budget Share

With the continuing shift from manned aircraft to missiles and increasing emphasis on space vehicles, the electronics industry should continue to get a larger share of the defense budget according to A. J. Catapano, industry spokesman for Merrill Lynch, Pierce, Fenner and Smith, investment bank, one who discussed the changing defense industry from the constant viewpoint.

Baltimore, the analyst has decided that the major beneficiaries of the missile space age will be the electronics and peripheral companies, Catapano declared. Since the launchings of Sputnik, I, the defense electronics group, as measured by the Merrill Lynch price index, of 510 stocks has outperformed the general market by some 400% and the shift from manned aircraft to missiles has outperformed even other major groups in the market, he said.

With a continuing shift from manned aircraft to missiles and the increasing emphasis on space vehicles, the electronics industry should continue to get a larger share of the defense budget, he claimed. Defense volume in the electronics industry could easily double by 1965, he pointed out, even assuming only moderate increases in the overall defense spending. This is an enormous potential compared with the long established growth rates such as the chemical and drug industries which are expected to expand by 10 to 15% annually, he explained.

Catapano said that a "shake-out" in electronics will happen over the next decade as weaker companies either disappear or are absorbed and the result will be a greater industry concentration

with the emergence of several large industry leaders. He qualified this by adding that since the industry primarily is more dependent upon ideas and the human equation than any other industry in U. S. history, the degree of concentration perhaps will be less than seen in most industries, with continuing opportunities for new small but soundly based enterprises.

Stock Factors

Outlining stock selection factors in the defense industry field, Catapano declared annual research and development expenditures in relation to sales should be substantial. "We prefer to see a company where at least a good portion of these outlays are company-sponsored because of the greater proprietary interest it derives from such activities. Nevertheless, large government-sponsored R&D programs can be extremely important as well," he said.



MERCURY pilot lies on back at launch, then backward throughout ascent. Dual parachute system provides pilot-escape backup.

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Chemical Ultraviolet Shield Studied

Transparent die, underlying mechanism for use on vision of space helmet, turns dark blue when exposed to ultraviolet light, forming a barrier against the sun. Die is being developed under a NASA research contract to permit space travelers from intense sunlight shielded by the atmosphere. Chemical, effective only when in the liquid state, must be manipulated in place. Developer of the material is the National Cash Register Co., Dayton, Ohio.

Barometric Altitude Control

Altitude controller for aircraft and missile applications operates in emergency mode as an altimeter, and engaged as an altitude controller.

Standard operating range is from sea level to 100,000 ft. with temperature control of ± 1 ft. between -55 and $+70^\circ\text{C}$. Velocity errors are effectively zero when engaged and under 50 ft/sec.



for rate of climb of 150,000 ft/sec when emergency. Its emergency mode height and barometric rate ± 0.25 ft. in 100 ft. up to 80,000 ft. When engaged, barometric rate ± 500 ft. error in ± 15 and barometric under 1 ft. error return to engage altitude. Weight

of controller is 43 oz. and dimensions are $4\frac{1}{2} \times 4\frac{1}{2} \times 6$ in.

General Controls Co., 501 Allen Ave., Glendale 1, Calif.



Electrical Connector

Nuclear miniature connectors, weighing 855 oz., are used for Air Force pilot helmet computers and other applications where size and weight are important factors.

The male and female sections are 490 and 150 oz. in length respectively, 936 in. wide and 455 in. deep.

Phenomenix Products Inc., Division of United States Gasket Co., Canada 1, N. J.

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Lubricofine, Englewood, 2709 Kent Ave., Ft. Worth, Tex.

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Fram Corp., Providence 16, R. I.

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Moisture instrument which continuously measures the quantity of moisture in liquids will detect quantities as low as one part per million. Primary application will be the monitoring of jet fuels.

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on intensified by a light sensitive photoelectric cell which controls gas pressure. Copper tubing coils inside the cone reduce the possibility of line leakage should an accident strike one of the lights. Cost of a 50-light system, installed in solution, was \$1,000. Aisle Air Conditioning Corp., 812 Main St., Little Rock, Ark.



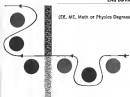
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WHO'S WHERE

(Continued from page 51)

Changes

Walter C. Mack, head of the newly established Advanced Product Planning Group Engineering Department, Hawthorne Standard Division of United Aircraft Corp. Under Little Com. Also George R. Dapkin, advanced product design engineer. Walter E. Arnold and Samuel J. Leming, senior technical specialists. David C. Jers, design, senior mechanical engineer.

George S. Cooke, assistant director of Engineering Operations (Aircraft Division), The United Corp., Baltimore, Md. Nicholas M. Voulas, assistant Mr. Cooke, as he directs engineering management, and Howard F. Dapkin, research Mr. Voulas, as team management manager.

John Coffey, staff specialist in aircraft design. George Dutton, Lockheed Aircraft Corp., Van Nuys, Cal. Also Mr. Dutton, assistant Mr. Coffey, as chief flight engineer.

Edward Menden, project manager for special systems (Aircraft Division), Calson Corp., Calif.

Robert J. Wright, director of marketing, Lockheed Division of General Mills, Van Nuys, Cal.

Dr. Robert H. Vukobrat, director of research and development, New Design Division, General Motors Corp., Buick.

R. H. Carpenter, special consultant on aircraft and aircraft systems, Aircraft Division, General Motors Laboratories, Flint, Pennsylvania, N. Y.

Frank G. Deaton, manager vehicle technology, Buick Laboratories, Aircraft Division, General Motors Corp., Buick, Flint, Michigan, Cal.

R. K. Ruckelshaus, chief of quality control (Aircraft Division), General Motors Corp., Buick, Flint, Michigan, Cal.

George B. Thompson, manager research and development, Buick Laboratories, Flint, Michigan, Cal.

Dr. Simon H. Randall, chief of weapon systems analysis, Buick Laboratories, Flint, Michigan, Cal.

Nicholas Menden, manager of the newly established corporate Market Research Department, Lockheed Aircraft Corp., Buick, Flint, Michigan, Cal.

William T. Swadlow, general manager of the Los Angeles operations, General Motors Corp., Buick, Flint, Michigan, Cal.

Paul F. Rothlis, structural research specialist, Aircraft Division, General Motors Corp., Buick, Flint, Michigan, Cal.

Thomas A. Campbell, chief engineer, Vehicle Division, Lockheed Aircraft Corp., Buick, Flint, Michigan, Cal.

Paul R. Mack, senior research Mr. Campbell, as manager of Lockheed's Van Nuys, Cal. office.

Edward R. Fisher, assistant technical director, subcommittee, General Motors Laboratories, Inc., Buick, Flint, Michigan, Cal.

Robert R. Chiles, chief of information systems, Buick.

Dr. L. B. Vukobrat, director of research, Buick Laboratories, General Motors Corp., Buick, Flint, Michigan, Cal.

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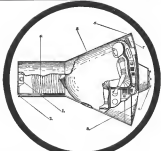
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NASA

National Aeronautics and Space Administration

LETTERS

NBAA's Role

I have just read your "Seasonal Flange's
List" column (VW April 6, p. 11) with
wonderful and warm interest and appreciation.

The closing paragraph could well be taken to be a tacit admission of this association's concern for customer and continued growth. To the business service giant, greater skills and performance pilot standards must be improved continuously. It is, let this memo tell NHTSA, published in *Recommended Standards Manual* last year. Among not only to provide the well-studied business pilot, but his message, that as well, guide lines for improvement in skills and efficiency as operators—the manual has been well accepted by the business pilots to get and what.

Professors, with new rankings and high student achievement will become a reality instead of a professional fever." It is for that purpose that NBSA holds annual meetings and regional meetings. The former NBSA's part in the World Congress of Flight which brought together government and industry experts to meet with NBSA members, airlines, and various personnel such as "Advanced Air Traffic Control" and "Advanced Navigation" etc.

[illegible]

This active participation by NHAA has been accomplished without incident. With our "a la carte" products, and—on the security level—has been not only accepted but welcomed by the neuro-mental system.

The increased availability of human remains to the FAA's Bureau of Flight Standards which integrated civil aviation into their entities, scheduled an initial business meeting and general aviation will further strengthen NPA's services to the business aviation community and to the commercial aviation.

Business action, as you can see, emphasis, has reached a tremendous status. The policy of NAW is to encourage each and every business owner and operator to recognize his responsibility to society, participate in all governmental affairs which affect his operations, and to share his knowledge with other business owners.

Autism Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, *Autism Week*, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 250 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

and operators. It is through such a program that the status of business being well so better recognized—rather than just through their weight in numbers of units and as being flow.

Atkinson Works, a consultant firm, reports Peter J. (Pete) Bellini is one of the most respected experts in the aviation field. We at NAVA find most fortunate that you have Pete on your staff and that he has business systems in his fragmented. Pete's coverage of the business aviation field including NAVA meetings has proven to have that rare, exceptional quality—qualitative and quantitative analysis—which is so greatly needed in this complex aviation field.

MELISSA K. LARSEN
Executive Director
National Business Council for
Welding, D.C.

Business Flying Facts

Congratulations on the first and last edition to the April 6 issue of *Nature* Week. You tell us the most important facts about genetic science and of human being as participants in life history.

It is supposed that the Illinois Legislative Council met April 7 and I took the session in and it is thought they had decided in Washington April 6 and had not yet sent it. So on writing this note I am also expressing the opinion of our Council members.

Joseph T. Gattuso—*is*
Manager
Utility Systems Group
American Industries, Inc.
Wilmington, D. C.

Helicopter Research

Your most article, *Skinny Breeds In VTNH Research* (WV Feb. 2, p. 66) brings the month of eating way more or helicopter for short into some-odd perspective. It is curious, however, that last way will be the helicopter primary use for long-term research growth we somehow omitted much the whole-line demands (alcohol which is contrast to what the work done the blood of a

die' traps, permit operations in both an exposed area and in populated areas. The fact that the more heavily loaded helicopters can take up dust to an extent producing serious visibility problems should serve to emphasize the unresolvable more serious problems for the more compact types of direct lift aircraft.

The release bars are a rod (or slipstream) velocity and the amount of dust or loose rock thrown above and around the velocity in which a man can walk or work, do not seem much affected by technological advances. In the dawn of all, the horse stands in the world which would become, consider today the same horse-horseman vs.

studies present in the special period, built off open access to create a project. This article recognizes the importance of starting as in the mentioned project in order to reach the real nature of what has been done at that point. In the end, it is said that, as in the case, do not participate in the enough nothing, not nothing and no on that, as well as the lack of help from the very mentioned area and a lack, all the mentioned options seem again, which people is required.

If the project is the use of technology, it is enough to understand it, it means that it is such as technology and related topics should be increased as proportionally time. Certainly, the technology needs to be

significant evidence showing processes of complex, kind change capable of determining all of these design approaches to railroad first cost and maintenance and improved performance are important current goals; but the research effort is still comparatively small. This research should be sponsored as such a way that all who have need for it could receive some

study levels of the study. The resulting long-run effect should then lead to the elimination of both needed educational and related improvements as an overgrowth located in transportation vehicle.

Approach Lighting

In this feature, *Nature's* Q&A, editorial for Feb. 9, 1995 and 1996 just wanted the reported results of the reviews of additional submissions of both the US and high income area approach lights—the responder design type

“It is true, every responsible person in a nation where I live considers his or her duty the effectiveness of these consumer discharge approach lights—bad weather and

Test it is impossible for yourself. Still, to learn of HLI, Urbaniak to obtain approval for our condensed discharge artificial light system. Through the procurement of SR-5075, we have, each installed 32 units on various types and a single dose of sunlight. Our natural and artificial light system. We have given through the most severe, nothing under all light conditions the positive and effects, compared to a affected results that are usually observed.

[illegible]

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